TA4000 400MHz
LOGIC ANALYSER

INSTRUCTION MANUAL

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Safety Regulations in Accordance with IEC 348

This instrument has been designed and tested in accordance with IEC Publication 348, Safety Requirements for Electronic Measuring Apparatus, and has been supplied in a safe condition. This instruction manual contains some information and warnings which have to be followed by the user to ensure safe operation and to retain the instrument in safe condition.

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Software

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Manual

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Section 1 - Specification

SIGNAL INPUTS

No. of data channels:	32, 48 or 80; 8 channels per data pod.
No. of clock inputs:	3 independent clock inputs; active edge can be independently selected on each to be either +ve, -ve, both or off.
No. of clock qualifiers:	5; 3 for clock A, 1 each for clocks B & C; selectable to be active high, low or don't care.
Impedance:	1MOhm//5pF.
Logic threshold:	TTL (+1.4V) or Variable. Independent variable thresholds for every data pod and each clock.
Variable threshold range:	-9.0 to +9.0V in 100mV steps.
Maximum input voltage:	+/-50V continuous.
Hysteresis:	100mV typical.
Minimum input overdrive:	250mV or 25% of input amplitude, whichever is greater.
Minimum detectable glitch:	<5ns
Data skew:	Typically better than 2.5ns.

ACTIVITY INDICATION

An activity indicator for each channel in the Trigger screen shows whether the channel input is high, low or switching.

INTERNAL CLOCK:

Clock Rate:	Period selectable 2.5ns (400MHz) to 100ms (10Hz) in a 1-2-4 sequence.

EXTERNAL CLOCK:

Number of clocks:	3 clocks which are independently qualified and ORed together.
Frequency range:	DC to 50MHz.
Minimum clock width:	6ns, 9ns qualified
Set-up and hold times:	Data 8ns/0ns; Qualifier 8ns/0ns

MEMORY CONFIGURATIONS

Model	Data channels	Glitch channels	Data memory depth	Max. frequency
TA4000-32	32	8	2K words	50MHz
	32	0	2K words	100MHz
	8	0	8K words	400MHz
TA4000-48	48	8	2K words	50MHz
	48	0	2K words	100MHz
	8	0	8K words	400MHz
TA4000-80	72	8	2K words	50MHz
	80	0	2K words	100MHz
	16	0	8K words	400MHz

TRIGGER

Trigger words: 8 words of up to the maximum selected channel configuration. Word 1 is ANDed with the glitch word when glitch mode is selected. Each word can be used in any number of sequence terms.

Sequence terms: The actual trigger and branch term searched for in a sequencer step consists of up to 4 trigger sequence words ORed together; the term can be selected to be True or NOTed.

Sequence steps: 8 steps in all, 7 of which consist of a search for the trigger and branch terms specified in that step. Each step has an event count of 1 to 256 occurrences of the trigger term. The 8th step provides for trigger delay.

Trigger & branch filter: Selectable to off or up to 16 clock periods. The term will be recognised when the selected bits have been valid for the specified number of successive clocks.

Trigger position: Selectable to be anywhere within the store or, using the trigger delay, up to 60K clocks before the start of store.

Trigger output: Programmable at any sequence step, providing a TTL signal out via a rear panel BNC.

QUALIFIED RECORDING

On entry to any trigger step data storage can be enabled or disabled.

GLITCH

Glitch channels: Glitch capture (5ns or better) is available on data channels D0 to D7.

Glitch triggering: When in glitch mode, any ORed combination of the 8 glitches may be ANDed with the trigger word 1. Glitch triggering is not available above 50MHz.

STORAGE

Reference Memory: Equal in size and configuration to the acquisition memory. Can be loaded from data memory or via RS232, IEEE or Memory Card interfaces.

Non-volatile Memory: Non-volatile storage of the current data and reference memories, 6 further acquisitions and 16 set-ups. Data retention by Lithium cell; typical life 5 years.

Memory Card: The analyser incorporates a memory card connector; the system accommodates both battery backed SRAM and EPROM cards upto 512Kbytes capacity. The SRAM cards can be used for both data and set-up storage; a data store uses 21Kbytes and a set-up 2Kbytes. The information stored can be both read from and written to an IBM PC via the RS-232 port.

TIMING DISPLAY

Number of channels: Any 17 channels, busses or scale (channels, busses and scale may be repeated) may be displayed simultaneously.

Channel labelling: Each channel can be uniquely labelled.

Bussed channels: Any labelled channel group can be selected to be displayed as a single line referred to as a "bus". The bus shows activity on any channel within the group.

Number of samples: Up to 1K words can be displayed with expansions of x2, x4, x8, and x16 available. The expansion window can be soft scrolled throughout the store and a window indicator shows the position of the window within the store.

Cursors: Two movable cursors and a fixed trigger marker are provided with direct readout of their absolute and relative store positions and the data values at those locations. The window indicator also shows the cursor positions within the store.

Glitch: When glitch is selected, glitches are shown as bold markers on the appropriate data channels. Data only or data plus glitch can be displayed.

Search: A search can be made for any word; the word may include a search for glitches on the glitch channels.

LIST DISPLAY

Channel groups: Up to 32 channels can be grouped together and given a single character label and a user defined name; up to 16 groups can be specified.

Display format: Binary, octal, hex, decimal or ASCII are individually selectable for each channel group. Each group is listed underneath its user-defined label.

Cursors: Two movable cursors and a fixed trigger marker are provided with direct readout of their absolute store positions. 16 consecutive store locations from the selected memory (data or reference) are displayed, starting from the cursor position; moving the cursor scrolls the data up or down.

View: Any trigger word or selected option cycle can be used to qualify or mask the data to be displayed. This allows only the required samples to be viewed.

Find and compare: Differences between data and reference memories can be highlighted and a search made for any word or option cycle (True or False) and any difference.

Automatic comparisons between data and reference memories can be performed on a user specified area of the data and acquisitions stopped on an equality or inequality. Occurrences of the equality or inequality can be counted.

SYSTEM DATA

Display: 7", non-glare, green CRT; 25 lines x 64 characters.

Interfaces: Full IEEE-488, Centronics and RS-232 ports. Composite video output (75Ohm, 1V p-p).

Audible warning signal: If required, an audible warning signal can be set from the keyboard to sound when a keyboard entry error is made or an acquisition is completed, or both.

HELP

The analysers feature full context sensitive help for every screen.

GENERAL

Power Supply: 90 - 265V AC, 47 - 63 Hz; 200VA max.

Environmental Operating Range: 5°C to 40°C, 20% to 80% RH.

Environmental Storage Range: -20°C to 50°C, 5% to 95% RH.

Size: 350mm(W) x 190mm(H) x 335mm(D) (13.75x7.5x13.2") excluding handle and feet.

Weight: 9.8kg (21.5lb) excluding pods.

Section 2 - Installation

2.1. MAINS OPERATING VOLTAGE

The TA4000 is a safety class I instrument, installation category II, by IEC classification.

The analyser has a universal input power supply which will operate from any AC line source in the range 90 to 265V AC, 47 to 63Hz.

2.1.1. Power Leads

When a three core power leads with bare ends is provided this should be connected as follows:-

BROWN	-	LIVE
BLUE	-	NEUTRAL
GREEN/YELLOW	-	GROUNDED

WARNING! THIS APPARATUS MUST BE GROUNDED

Any interruption of the protective conductor inside or outside the apparatus or disconnection of the protective ground terminal is likely to make the apparatus dangerous. Intentional interruption is prohibited.

2.1.2. Fuses

Two separate switched mode power supplies are fitted, each protected with a fuse fitted on the power supply pcb. In the event of fuse failure, replace only with one of an identical type, see markings on each power supply pcb and fuse.

To access the fuses, disconnect the instrument from the AC line, remove the 6 screws (2 on each side) which secure the top cover, and lift off the cover. Then remove the CPU (upper) pcb by undoing the two screws which hold the hexagonal support pillars to the chassis and the six screws which retain the connectors to the rear panel; it will also be necessary to unplug the fan and Video Out connections from the CPU.

Make sure that only fuses with the required rated current and of the specified type are used for replacement. The use of makeshift fuses and the short-circuiting of fuse holders are prohibited.

Reassemble in the reverse order.

2.2. SAFETY AND OPERATING PRECAUTIONS

This instrument has been designed and tested in accordance with IEC Publication 348, Safety Requirements for Electronic Measuring Apparatus, and has been supplied in a safe condition. The instrument has been designed for indoor use. It may occasionally be subjected to temperatures between +5°C and -10°C without degradation of its safety. Use of the instrument in a manner not specified by this manual may impair the protection provided. In particular, operation outside of the rated mains operating voltage and environmental range may impair safety.

Do not obstruct the fan inlet or ventilation exit holes in the rear panel covers. The instrument may be operated in tilted position using the handle/ stand, or stood on the rear panel cable stowage feet.

When moving the instrument from a cold to a warm ambient temperature allow a period of acclimatisation before switching on because condensation could cause malfunction, particularly of the EHT in the monitor.

When the instrument is connected to its supply, terminals may be live, and the opening of covers or removal of parts (except those to which access can be gained by hand) is likely to expose live parts.

The instrument shall be disconnected from all voltage sources before it is opened for any adjustment, replacement, maintenance or repair.

Capacitors inside the instrument may still be charged even if the instrument has been disconnected from all voltage sources.

Any adjustment, maintenance and repair of the opened instrument under voltage shall be avoided as far as possible and, if inevitable, shall be carried out only by a skilled person who is aware of the hazard involved.

Safety Symbols

means that the marked terminal is connected to accessible conductive parts. The outers of the coaxial sockets are all connected to the instrument ground and to the protective earth terminal.

3.1. INTRODUCTION

This section describes how the TA4000 is made operational and introduces the user to the keyboard, the menus and the data displays.

3.2. POWER

Plug the power cord into the rear panel receptacle and switch the instrument on using the POWER switch on the rear panel. The fan will start and after a few moments the display will show <TA4000 400MHz LOGIC ANALYSER>; press any key to show the default Configuration menu, see fig 3.1, which is described fully in section 4.

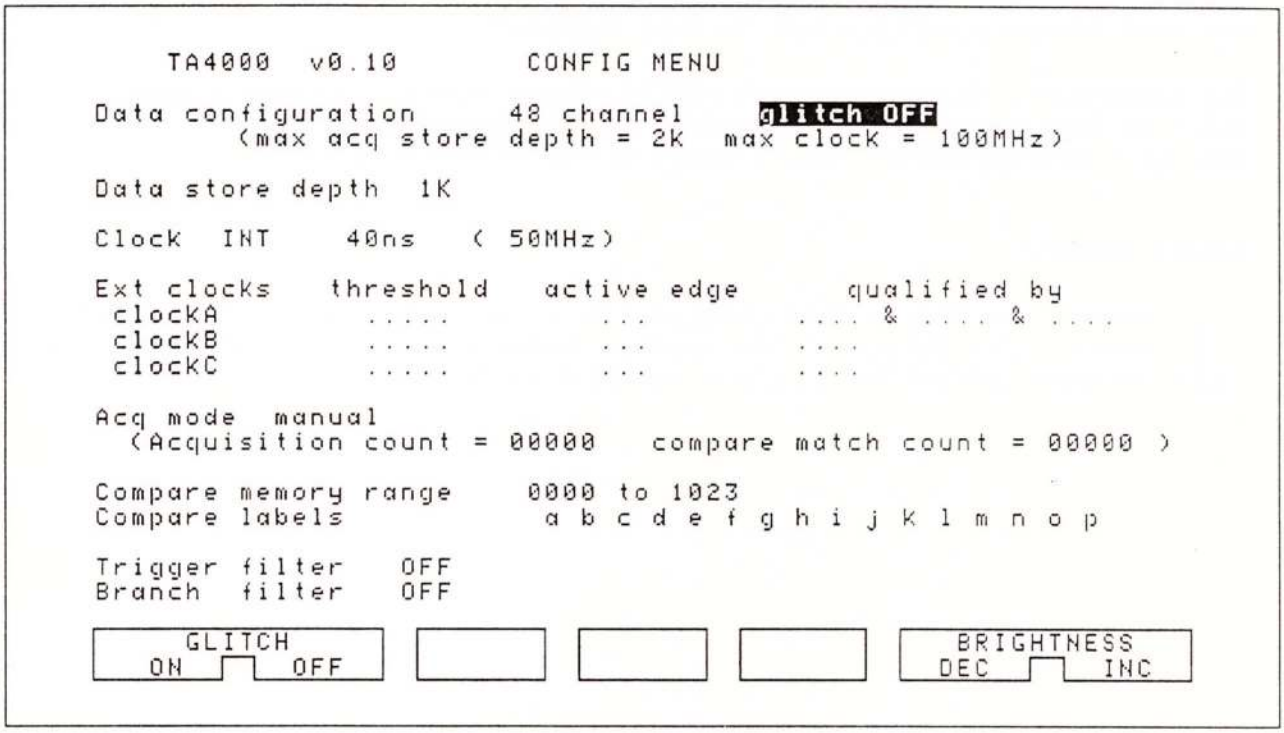

TA4000 v0.10 CONFIG MENU
Data configuration 48 channel glitch OFF
(max acq store depth = 2K max clock = 100MHz)
Data store depth 1K
Clock INT 40ns (50MHz)
Ext clocks threshold active edge qualified by
clockA .... & .... & ....
clockB ....
clockC ....
Acq mode manual
(Acquisition count = 00000 compare match count = 00000)
Compare memory range 0000 to 1023
Compare labels a b c d e f g h i j k l m n o p
Trigger filter OFF
Branch filter OFF
GLITCH
ON OFF
BRIGHTNESS
DEC INC

fig 3.1.

Immediately on power-up the instrument perform a memory self-test and a hardware configuration check (32-,48-, or 80- channels) and sets the "Data configuration" line of the display appropriately; this is accompanied by a number of beeps from the buzzer.

3.3. KEYBOARD

The keys on the front panel can be considered in 4 groups, viz. soft-keys, menu and data display keys, cursor keys and alpha-numeric keys.

3.3.1. Soft-keys

The 7 keys under the CRT each take the function shown immediately above them on the display; see, for example, fig 3.1. As the cursors move the edit zone (reverse video block) around the editable fields of the display, the functions shown in the boxes change and hence the functions of the keys change; for this reason they are known as soft-keys.

3.3.2. Menu and Data Display Keys

The 6 keys in 2 vertical columns of 3 directly to the right of the display give direct access to the 6 menus and data displays through which the instrument is controlled and results are presented; the operations accessible through each display are presented in detail in sections 4 to 9. Briefly the features accessed by each key are:

CONFIG - CONFIGuration MENU. Selection of the instrument configuration, clock parameters, acquisition modes, trigger/restart filter settings and display brightness.

TRIGGER - TRIGGER MENU. Specification of the data pod thresholds, the trigger words and the trigger sequence.

TIMING - TIMING DISPLAY. Presentation of the acquired data as a waveform display with magnify, find, etc. features.

LIST - LIST DISPLAY. Presentation of the acquired data as a state list display in the selected bases (binary, octal, hex, decimal, ASCII and microprocessor mnemonics) with find, compare, etc, features.

UTILITIES - UTILITIES MENU. Primarily for the saving of data and set-ups to non-volatile memory and memory card, and for specifying the communications interfaces.

OPTIONS - OPTIONS MENU. For calling up the installed options, such as microprocessor disassembly software.

3.3.3. Cursor Keys

The cluster of 4 arrowed cursor keys have 2 basic modes of operation viz. moving the edit zone (reverse video block) around menu displays (and data displays if EDIT is switched on) or moving the cursor in the TIMING and LIST data displays.

When used to move the edit zone in menu displays (and data displays when EDIT is switched ON) the RIGHT and LEFT cursor keys move the edit zone along the line of the display to the next editable parameter field, and the UP and DOWN keys move the edit zone up or down to the next line containing an editable parameter field. Note that, when the edit zone is in the rightmost editable field of a particular line, a further press of the RIGHT cursor key will take the edit zone to the leftmost editable field of the line below; similarly if the edit zone is in the leftmost editable field of a particular line, a further press of the LEFT key will take the edit zone to the rightmost editable field of the line above. It is therefore always possible to move the edit zone through all the editable parameter fields of a menu using the RIGHT and LEFT cursor keys only.

When the edit zone is in the bottom line of the display a further press of the DOWN key will bring it to the top line of the display; similarly if the edit zone is in the top line of display a further press of the UP key will bring the edit zone to the bottom line of the display, i.e. the display 'wraps-round' as far as the cursor is concerned.

In the TIMING data display the LEFT and RIGHT cursor keys are used to move the cursor or marker through the acquired data and the UP and DOWN keys can be used to scroll any 17 channels or scale into view. In the LIST data display the UP and DOWN cursor keys can be used to scroll through the complete store and the LEFT and RIGHT keys can be used to bring all specified channel groups into view. In both data displays, when EDIT is turned ON the cursor keys move the edit zone around the editable fields as in MENU displays.

3.3.4. Alpha-numeric Keys

The majority of parameters are set using the soft-keys. However, several are more easily set with direct alpha-numeric entries, such as event and delay counts, character labels for channel groups, etc. The alpha-numeric keypad provides direct entry of all hex characters plus X (don't care) and the shift key allows all the other alpha characters to be used for labels, etc.

Note that SHIFT remains operational until it is pressed a second time or until any other key which does not have a shifted function is pressed. Shift mode is always indicated by the message <SHIFT enter letter> in reverse video at the top right-hand corner of the display.

Also grouped with these keys are the RUN and STOP keys whose functions are fully described in 'Making an Acquisition', see section 10.1.

3.3.5 Help Key

The HELP key calls extracts from this manual into the display which are relevant to the current position of the edit zone, i.e. HELP messages are context sensitive.

3.4. PODS, CABLES AND PROBES

3.4.1. Introduction

The TA4000 has 2 types of pod. The data pods all have 8 inputs and are electrically identical with each other and therefore interchangeable; however, for identification purposes each pod is uniquely numbered and it is recommended that they are only used in their designated positions because the specified parameters are only set-up and guaranteed under that condition. The clock pod has 3 separate clock inputs each independently qualified by a total of 5 clock qualifiers, i.e. it also has a total of 8 signal inputs.

The clock and data pods are physically and electrically interchangeable and no damage will result if they are swapped accidentally. However, the signal delays are different for the two pod types and the analyser will not work correctly with the pods interchanged.

3.4.2. Connecting the Pods to the Analyser

All pods are plugged into their appropriate connectors along the bottom edge of the front panel.

To connect a pod, proceed as follows:

i) Open out the latching levers of the connector, see fig 3.2.(a)

ii) Insert the socket at the end of the pod's cable into the corresponding front panel connector. The socket moulding is polarised with a 'bump' so that it can only be inserted one way round, see fig 3.2.(b).

iii) Press the socket fully home and lock it in position by closing the latching levers, see fig 3.2.(c).

The pod can be disconnected again by opening out the latching levers until the socket is ejected.

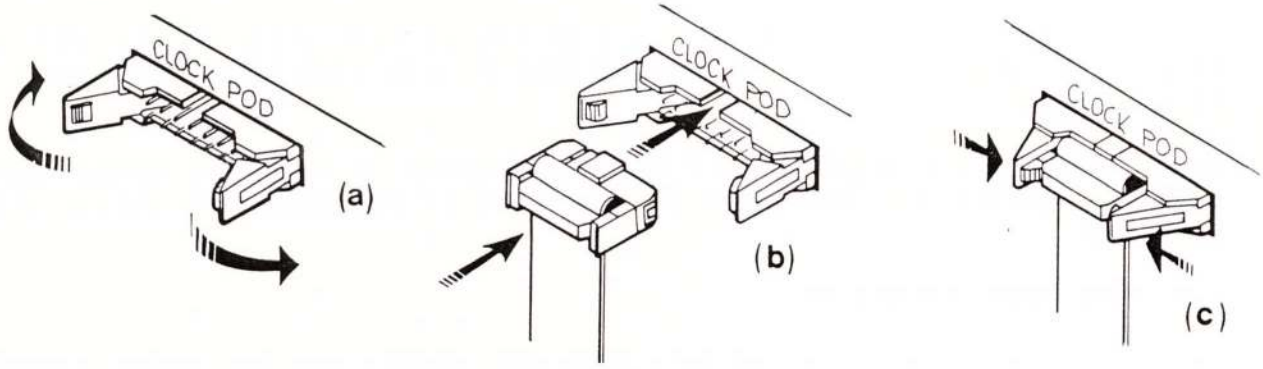


fig 3.2.

3.4.3. Connecting the Test Leads and Grabber Probes to the Pods

The test lead sets are the same for both types of pod. In each case the leads are fitted to a 12-way socket which plugs into the end of the pod. The lead-set has been made detachable in this way so that it is possible to connect all the test leads to the circuit under test and then finally connect the pod(s) to the lead set(s). The 12-way connectors and mating header in the pod are polarised as shown in fig 3.3. Note that the 12-way connectors are always fitted such that the small raised rib on the connector is at the end with channel number 0 (data pods) or clock letter A (clock pod).

To remove the lead-set, squeeze the sides of the connector and withdraw, see fig 3.3.

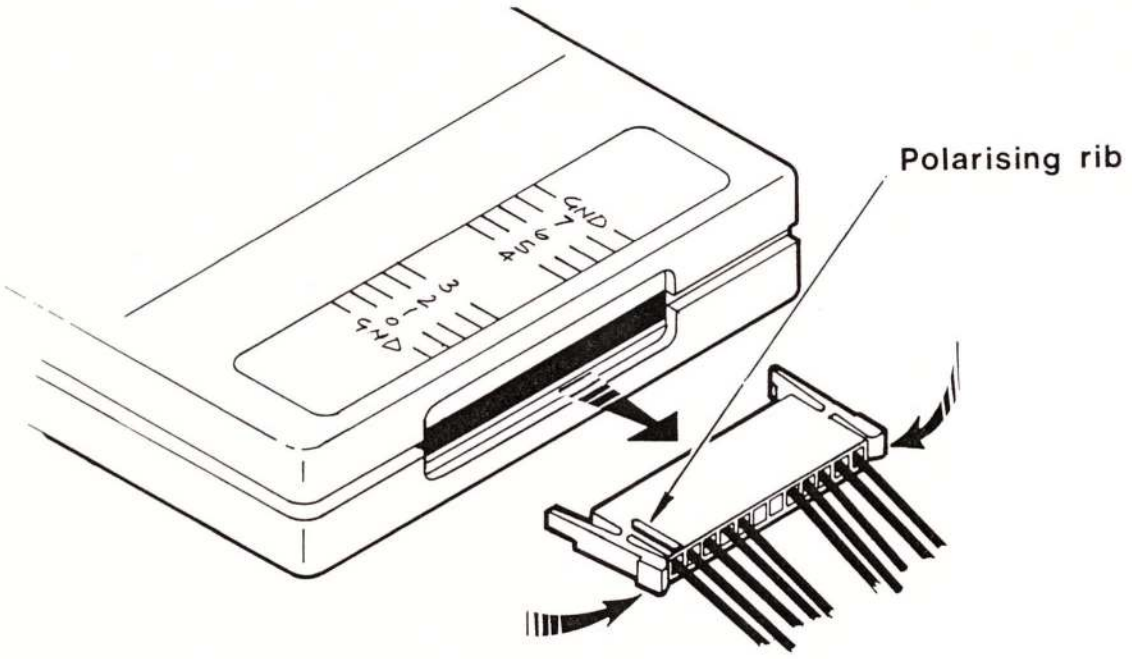


fig 3.3.

The free end of each lead is fitted with a long-life socket that will connect to the pin of the grabber probes supplied or to any other standard .025" (0.64mm) square or 0.25" diameter pin, e.g. a wire-wrap post. Note that the socket may become permanently deformed and loose-fitting if it is forced over a larger pin such as those of some IC test clips (.030" or more).

For microprocessor disassembly a special set of test leads is provided with each option which connects the appropriate IC test clip to all the necessary analyser pods.

When connecting the input pods to the target system at least one ground lead on each pod, preferably both, must be connected to the target to ensure signal integrity.

3.5. REAR PANEL CONNECTIONS

On the rear panel are the standard IEEE-488, RS-232 and Centronics interface connectors, together with BNC sockets for Composite Video Out and Trigger Out. These signals will each be described in more detail in the appropriate sections.

3.6. ADJUSTING THE OPERATING POSITION

To adjust the handle/stand position, press both sides of the handle in towards the case at the pivot points and swivel the handle to the desired position.

With the handle on top, the instrument may be operated horizontally. Alternatively, the handle/stand can be used to tilt the instrument, or the cable-stowage feet can be used to operate it vertically; particular care should be taken not to obstruct the fan inlet when used in the latter position.

Section 4 - Configuration Menu

4.1. INTRODUCTION

The Configuration menu, accessed by pressing the CONFIG key, has three principle functions. The first is the selection of the basic configuration of the instrument, i.e. glitch on or off and memory depth. The second is the clock selection including, if external clock is selected, the specification of the thresholds, active edges and qualifiers of the external clocks. Thirdly, the menu is used to specify the acquisition mode, including the comparison ranges if automatic modes are selected.

In addition, the trigger and branch filter values are set on this menu, as is the display brightness.

Fig 4.1. shows the default Configuration menu.

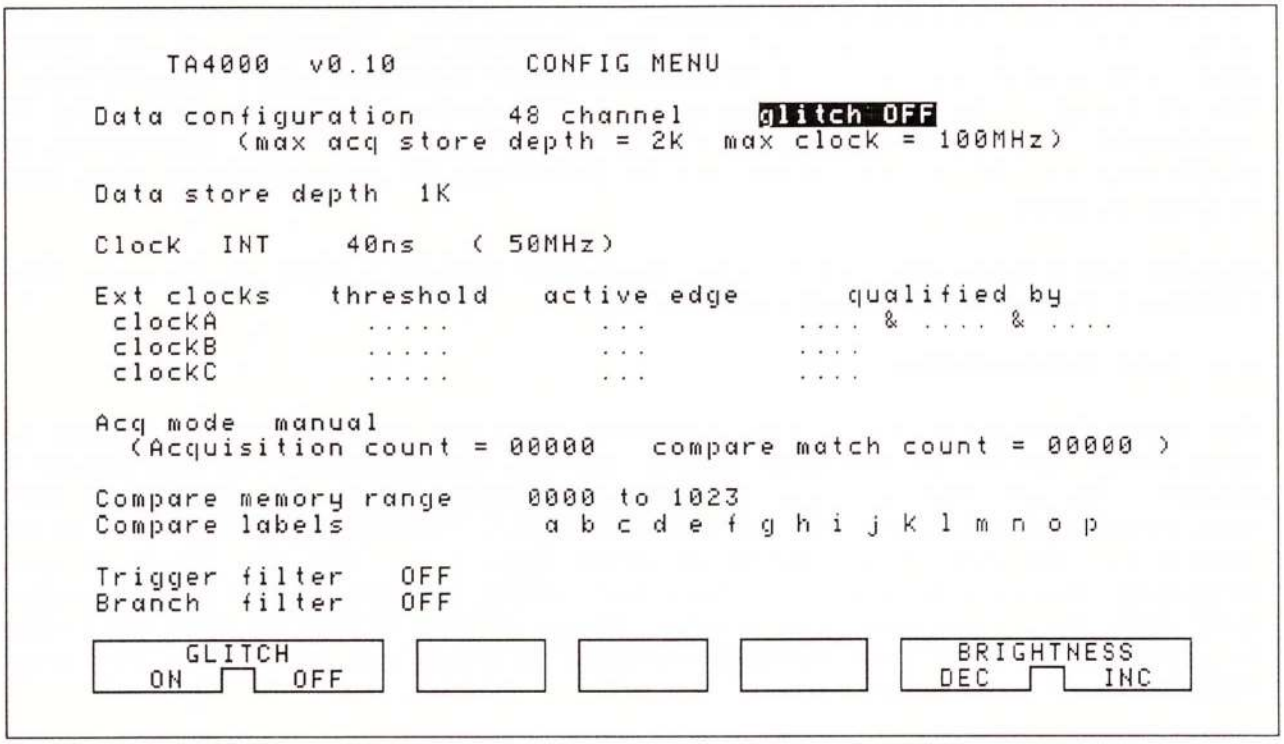

TA4000 v0.10 CONFIG MENU
Data configuration 48 channel glitch OFF
(max acq store depth = 2K max clock = 100MHz)
Data store depth 1K
Clock INT 40ns (50MHz)
Ext clocks threshold active edge qualified by
clockA .... & .... & ....
clockB ....
clockC ....
Acq mode manual
(Acquisition count = 00000 compare match count = 00000)
Compare memory range 0000 to 1023
Compare labels a b c d e f g h i j k l m n o p
Trigger filter OFF
Branch filter OFF
GLITCH
ON OFF
BRIGHTNESS
DEC INC

fig 4.1.

The revision of the installed software is displayed on the top line to the left of <CONFIG MENU> until the first acquisition is run; the status of the current acquisition will be displayed in its place once the RUN key has been pressed. To the right of the title editing prompts or warnings appropriate to the position of the edit zone and/or the acquisition currently in progress will be displayed.
Below this line is the main part of the display where all the parameter fields can be set up.

At the bottom are the soft-keys used when editing the display.

The Configuration menu is edited by moving the edit zone (reverse video block) to the appropriate parameter field. The edit zone is moved around the editable parameter fields by the cursor keys as described in section 3.3.3. Note that on some lines more than one field can be edited at a time, using the appropriate soft-keys, without extra cursor moves.

Acquisitions can be initiated and stopped from the Configuration menu but no parameters can be edited on the menu while the acquisition is running. If editing is attempted during an acquisition the warning message <no edit during acq> will be shown on the right-hand side of the top line of the display.

4.2. DISPLAY BRIGHTNESS

GLITCH					BRIGHTNESS	
ON	OFF				DEC	INC

Soft-key representation

The above soft-key representation shows the soft-keys for the default status of the Configuration menu after power-up, see fig 4.1. Display brightness is also initially defaulted to a typical operating level but can be DECreased or IN-Creased using the <DEC> or <INC> soft-keys.

If the display brightness is changed, the new setting will be taken as the default value when the instrument is next switched on. However, if the instrument is switched off with the brightness below a preset limit (approximately 20% of range), then the factory-set typical default will be used when the instrument is next switched on; if the display is 'lost' by decreasing the brightness too far it can therefore be recovered by switching the instrument off and on again.

Display brightness soft-keys also show when the edit zone is in some other parameter fields of the Configuration menu.

4.3. DATA CONFIGURATION

The <Data Configuration> field, together with the <max acq store depth> and <max clock> fields on the line below, are for information only and cannot be edited. The information shown in these fields depends on the particular hardware configuration (32-, 48- or 80- channels), whether glitch is ON or OFF (see 4.4), the data store depth selected (see 4.5), and the internal clock frequency chosen (see 4.6.1). These last three parameters are interdependent and, when one is changed, the display values of any or all of them will alter to reflect the compatible maximum settings allowed, see the MEMORY CONFIGURATION table of the specification.

If changing a parameter causes an incompatible combination to be selected then the message <warning depth > max> or <warning clock > max> will be displayed in reverse video on the right-hand side of the top line of the display, as appropriate. Such settings will, in fact, be accepted but the message will remain displayed until an allowable combination has been selected by changing one or other of the interdependent parameters. Furthermore, it will not be possible to exit from the Configuration menu, or run an acquisition, until such compatibility has been established.

4.4. GLITCH SELECTION

GLITCH					BRIGHTNESS	
ON	OFF				DEC	INC

Soft-key representation

The above soft-key representation is for the default condition of <glitch OFF>. Select glitch ON or OFF with alternate presses of the <GLITCH ON/OFF> soft-key.

For an 80-channel instrument the <Data configuration> message will change to show that only 72 channels are available with <glitch ON>. The message <warning depth > max> will show if glitch is selected with the store depth set to 8k, and the message <warning clock > max> will show if glitch is selected with the internal clock set to greater than 50MHz, see Specification and section 4.3.

It will not be possible to exit from the Configuration menu, or run an acquisition, until compatibility is established between the glitch, store depth and internal clock parameters.

4.5. DATA STORE DEPTH

STORE DEPTH					BRIGHTNESS	
1k	2k	8k			DEC	INC

Soft-key representation

The <Data store depth> can be set to 1k, 2k or 8k providing the set value is no greater than the maximum permitted for the clock frequency selected, i.e. the store depth must be set to 2k or less for clock frequencies of 100MHz or lower. If a store depth is selected which is greater than that permitted for the clock frequency set, then the message <warning depth > max> will be displayed in reverse video on the right-hand side of the top line of the display. Such a setting will, in fact, be accepted but the message will remain displayed until either an allowable store depth has been entered or until the data configuration has been changed to one compatible with the store depth required. Furthermore, it will not be possible to exit from the Configuration menu, or run an acquisition, until such compatibility has been established.

4.6. CLOCK SPECIFICATION

4.6.1. Internal Clock

	CLOCK				BRIGHTNESS	
EXT/INT	INC	DEC			DEC	INC

Soft-key representation

At power-up the clock is defaulted to INTernal clock and 20ns period (50MHz); the soft-keys are as shown above.

Alternate presses of the extreme left soft-key <EXT/INT> select between EXTernal and INTernal clock. If EXTernal is selected the soft-keys change and further parameter fields on subsequent lines of the display can be edited, see section 4.6.2.

With INT clock selected the clock period can be INCreased or DECreased in a 1:2:4 sequence using the <INC> or <DEC> soft-keys. For information only (i.e. it is not an editable field) the equivalent clock frequency is shown in brackets after the clock period field.

The INTernal clock period can be set from 100ms (10Hz) to 2.5ns (400MHz). Note that the range of values 'wraps-round' such that INCreasing the period when it is already at maximum (100ms) sets the clock to 2.5ns and DECreasing the period when it is already at minimum (2.5ns) sets the period to 100ms.

If <glitch ON> has been selected and a clock period is then set which is smaller than 20ns (50MHz) then the message <warning clock > max> will be displayed in reverse video on the right hand side of the top line of the display. Such a setting will, however, be accepted but the message will remain displayed until either an allowable clock period has been selected or until glitch is turned OFF. Similarly, if 8k store depth has been selected and a clock period of 10ns (100MHz) or greater is set, then the message <warning depth > max> will be displayed until store depth or clock period is changed. Furthermore, it will not be possible to exit from the Configuration menu, or run an acquisition, until such compatibility has been established.

4.6.2. External Clock

With the edit zone still in the <clock> parameter field, selecting EXTernal clock changes the soft-keys from those shown in 4.6.1. to the following:

CLOCK EXT/INT					BRIGHTNESS DEC	INC

Soft-key representation

With EXTernal clock selected, the parameter fields associated with the EXTernal clock (<threshold>, <active edge> and <qualified by>) now display default values and these fields can be edited by moving the edit zone to them. Compare the Configuration menu shown in fig 4.2, which has EXTernal clock selected, with the default display of fig 4.1 which has INTernal clock specified.

With the edit zone in the <clock> parameter field it is now only possible to reselect INTernal with a further press of the EXT/INT soft-key.

```
    TA4000  v0.10        CONFIG MENU

Data configuration      48 channel     glitch OFF
        (max acq store depth = 2K   max clock =  50MHz)

Data store depth  1K

Clock  EXT

Ext clocks    threshold    active edge       qualified by
 clockA          TTL           +ve        QA1=X & QA2=X & QA3=X
 clockB          TTL           off        QB1=X
 clockC          TTL           off        QC1=X

Acq mode  manual
  (Acquisition count = 00000    compare match count = 00000 )

Compare memory range     0000 to 1023
Compare labels            a b c d e f g h i j k l m n o p

Trigger filter    OFF
Branch  filter    OFF

 CLOCK                                          BRIGHTNESS
 EXT/INT                                        DEC    INC
```

fig 4.2.

4.6.2.1. External Clock Threshold

TTL	INC	DEC	ACTIVE	QUALIFIER		
+1.4V	+100mV	-100mV	EDGE	QA1	QA2	QA3

Soft-key representation

When the edit zone is moved into the <clock A> line of the display the soft-keys change to those shown above. The soft-keys are similar for <clock B> and <clock C> with the exception that the <QUALIFIER> soft-keys change to show only QB1 and QC1 respectively.

The thresholds are INcreased or DECreased in 100mV steps using the <INC> or <DEC> soft-keys. The TTL compatible threshold can be set directly using the <TTL> soft-key; a threshold of +1.4V is always shown as <TTL> in the parameter field regardless of whether it has been set by that key or by using the <INC> and <DEC> keys.

Similarly a threshold of -1.3V is always shown as <ECL> in the parameter field.

The 3 separate clock inputs (A,B and C) can have their thresholds independently set to any value in the range -9.0V to +9.0V. The range of values 'wraps-round' such that decreasing -9.0V by a further step sets the threshold to 9.0V and increasing 9.0V by a further step sets the value to -9.0V.

4.6.2.2. External Clock Active Edge

TTL	INC	DEC	ACTIVE	QUALIFIER		
+1.4V	+100mV	-100mV	EDGE	QA1	QA2	QA3

Soft-key representation

The active clock edge can be set to <+ve>, <-ve>, <both> or <off> with repetitive presses of the <ACTIVE EDGE> soft-key. The active edge can be independently set for the 3 separate clock inputs. Setting the active edge to <off> disables that clock and its associated qualifier(s).

4.6.2.3. External Clock Qualifiers

TTL	INC	DEC	ACTIVE	QUALIFIER		
+1.4V	+100mV	-100mV	EDGE	QA1	QA2	QA3

Soft-key representation

With the edit zone in the <clock A> parameter fields the soft-keys are as shown above. Pressing either <QA1>, <QA2> or <QA3> soft-key increments the setting of the corresponding qualifier field through the possible values of 1, 0 or X (don't care). When the edit zone is in the <clock B> or <clock C> parameter field the corresponding soft-key <QB1> or <QC1> can be used to independently set the value of the qualifier in the same way.

The threshold values used for the qualifiers are those of their associated clocks.

4.7. ACQUISITION MODE

4.7.1. Manual Mode

```
  ====================  =========  =========  ================================
        ACQ MODE
   MANUAL        AUTO
  =========  =========  =========  =========  =========  =========  =========
```

Soft-key representation

When the edit zone is in the <Acq mode> parameter field and <manual> is selected (the power-up default setting), the soft-keys are as above. Pressing <AUTO> will cause further editable parameter fields to show and the other 5 soft-keys to be made active, see section 4.7.2. Pressing <MANUAL> will return the instrument to manual mode.

In manual mode, a single acquisition is initiated by pressing the RUN key. Whilst the acquisition is in progress the message <Acquisition running> will be shown on the left-hand side of the top line of the display. This message will change to <Acquisition complete> if the acquisition successfully finishes or to <Acquisition aborted> if it is terminated by pressing the STOP key.

In addition, several possible information or warning messages may be shown on the right-hand side of the top line of the display during and after an acquisition; for example, the message <warning slow clock> will be displayed if RUN is pressed with EXTernal clock selected but no clock signal connected. All such messages are more fully explained in 'Making an Acquisition', see section 10.2.

When in <manual> mode, the <Acquisition count> field on the information line (in brackets below the <Acq modes> field) will be reset to 00000 when RUN is pressed and increment to 00001 when the acquisition is finished. If the acquisition is aborted but some valid data has been acquired then the <Acquisition count> will still increment to 00001; it will only remain at 00000 if no data has been acquired.

The <compare match count> field is inoperative in <manual> mode, as are the <Compare memory range> and <Compare labels> parameter fields.

4.7.2. Auto-repeat Mode

```
  ====================  ================================  ====================
        ACQ MODE                  STOP WHEN                      PAUSE
   MANUAL      AUTO      ACQ=REF   ACQ≠ REF   ABORTED       INC        DEC
  =========  =========  =========  =========  =========  =========  =========
```

Soft-key representation

Pressing the <AUTO> soft-key whilst in manual mode (see section 4.7.1.) causes the soft-keys shown above to become active; pressing <MANUAL> will return the soft-key status to that shown in section 4.7.1.

When <AUTO> is pressed, the <auto repeat> mode is selected and further editable parameter fields become active, see fig 4.3.

Now when the RUN button is pressed acquisitions will be initiated, completed and re-initiated as specified by these additional parameter fields; the message <Auto acq running> will be shown on the left-hand side of the top line of the display whilst the acquisition is running and the message <Acquisition complete> will be shown between one acquisition and the next. In all cases, however, acquisitions can also be stopped at any time by pressing the STOP key

which operates as follows in auto-repeat modes. The first press of STOP during an auto acquisition effectively changes the acquisition to manual mode; the message <Auto acq running> changes immediately to <Acquisition running> (the manual mode message) and no further acquisitions are initiated when the present one is completed (indicated by the message <Acquisition complete>). If STOP is pressed a second time before the acquisition is completed then the acquisition is immediately terminated and the message changes from <Acquisition running> to <Acquisition aborted>; no further acquisitions are initiated until RUN is pressed again. Between acquisitions, however, only one press of STOP is required to inhibit further acquisitions; if STOP is pressed at <Acquisition complete> the message remains unchanged and if it is pressed during <Auto pause> (see section 4.7.2.2) the message will change to <Acquisition complete>.

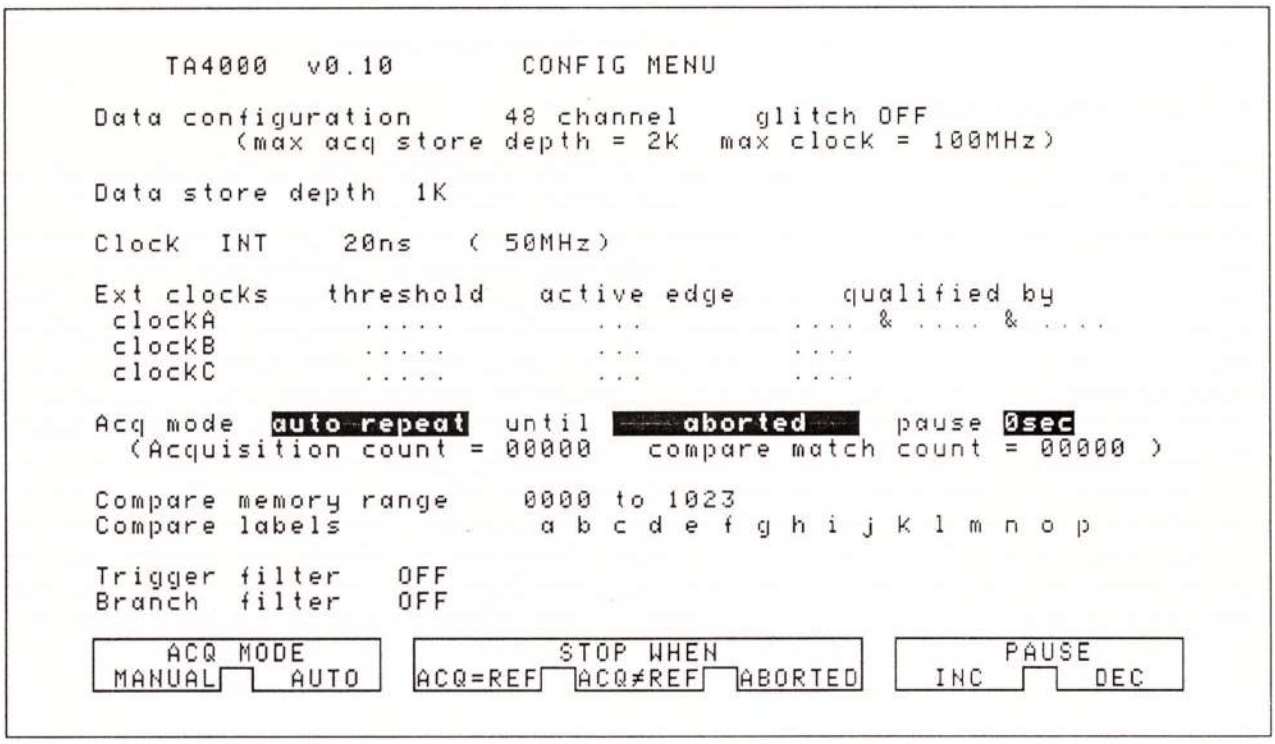

TA4000 v0.10 CONFIG MENU
Data configuration 48 channel glitch OFF
(max acq store depth = 2K max clock = 100MHz)
Data store depth 1K
Clock INT 20ns (50MHz)
Ext clocks threshold active edge qualified by
clockA .... & .... & ....
clockB ....
clockC ....
Acq mode auto repeat until aborted pause 0sec
(Acquisition count = 00000 compare match count = 00000)
Compare memory range 0000 to 1023
Compare labels a b c d e f g h i j k l m n o p
Trigger filter OFF
Branch filter OFF
ACQ MODE
MANUAL AUTO
STOP WHEN
ACQ=REF ACQ≠REF ABORTED
PAUSE
INC DEC

fig 4.3.

4.7.2.1. Auto-repeat Conditions

The three possible auto-repeat modes are selected by the three <STOP WHEN> soft-keys.

Pressing <ACQ=REF> sets the condition that, when RUN is pressed, acquisitions will be repeated until the acquired data matches the data held in reference memory for the specified store locations and channels, see section 4.7.2.3 and 4.7.2.4.

Pressing <ACQ≠ REF> sets the condition that, when RUN is pressed, acquisitions will be repeated until the acquired data does not match the data held in reference memory for the specified store locations and channels, see sections 4.7.2.3 and 4.7.2.4.

Pressing <ABORTED> sets the condition that, when RUN is pressed, acquisitions will continue until halted by pressing the STOP key as described previously.

In each case, the number of acquisitions made is shown on the <Acquisition count> field of the information line and the number of successful matches with the specified part of the store, is shown in the <compare match count> field.

The maximum count for both fields is 32,000; if the count exceeds this it is shown as <32000+>.

4.7.2.2. Auto-repeat Repeat Rate

The time between repeated acquisitions can be set by the <PAUSE> soft-keys to be between <0 sec> (immediate repeat) and <9 secs>; the time can be INCreased from the default value of <0 sec> using the <INC> soft-key and DECreased again using the <DEC> soft-key.
The pause time can also be set by direct numeric entries from the keyboard. The purpose of this feature is to provide a pause during which the user can visually inspect data, especially Timing Displays, before the next acquisition is made. The pause between acquisitions is indicated by the message <Auto pause> on the left-hand side of the top line of the display; pressing the STOP key once during this pause will inhibit further acquisitions and change the message to <Acquisition complete> as described previously.

4.7.2.3. Compare Memory Range

If the auto-repeat acquisition mode has been selected, the DOWN cursor key can be used to move the edit zone into the first <Compare memory range> field. The store location from which the comparison will be started is defined by decimal entries from the keyboard. Keyboard entries are made 'calculator-style', i.e. store location 1000 is entered as 1,0,0,0; each entry appears in the least significant position and increments the previous entry to the next significant digit on the left. Four key entries fill the field; the next entry will be interpreted as the first digit of a new store location and will therefore be shown in the least significant position with all other digits shown as zeroes. A low-numbered location can be entered either as, for example, 0,0,2,1, or as 2,1,X where X terminates the entry; moving the edit zone out of the field also terminates the entry. The RIGHT cursor can then be used to move the edit zone to the next editable field and the store location at which the comparison will be stopped can be defined by decimal entries from the keyboard. Both the start and stop store locations are included in the comparison; if either location is outside of the range of the selected data store depth (see section 4.5) the entry will be accepted but the <compare match count> information field will show <.....> to indicate that one or both entries are illegal and that no auto-compare will be made. Entries will also be treated as illegal if the stop location is not equal to or higher than the start location. The default values of the start and stop compare locations are 0000 and 1023 respectively.

Comparisons can only be made if the data configuration of the reference memory is the same as that currently set. If it is not the same, the <compare match count> information field will show <......> to indicate that no auto-compare can be made. Comparisons can be made if the reference store depth is different, but only across those locations which are valid in both memories.

4.7.2.4. Compare Labels

```
  ====================  =========  =========  =========  =========  =========
     COMPARE LABELS
    CLEAR       ALL
  =========  =========  =========  =========  =========  =========  =========
```
Soft-key representation

The default setting for this field is all 16 labels (a through p) such that comparisons are made across all channels of the instrument, regardless of how the channels have been grouped and labelled in the Trigger menu, see sections 5.3 and 5.4. This condition can also be reached from any other setting by pressing the <ALL> soft-key.

Pressing the <CLEAR> soft-key clears all the labels from the <Compare labels> field and permits the required labels to be specified using character entries from the keyboard; the TAB key is used to enter characters to <p> inclusive. Note that the labels will always be stored in alphabetical order, regardless of the order in which they are entered.

4.8. TRIGGER FILTER

```
================================  =========  =========  =========  =========
         TRIGGER FILTER
    OFF         INC         DEC
=========  =========  =========  =========  =========  =========  =========
```

Soft-key representation

The trigger filter specifies how long the specified trigger term must be present before it is accepted as a valid trigger for the <find term> field of the trigger sequence. The time is specified as counts of the system clock; the default value is OFF (i.e. 1 clock) and the maximum count is 16 clocks. The trigger filter is INCreased, starting at 2 clocks, by pressing the <INC> soft-key and DECreased by pressing the <DEC> soft-key; the <OFF> soft-key sets the trigger filter to OFF. The resolution of the trigger filter when ON is +1-0 clocks, which means that it guarantees not to trigger if the trigger event exists for less than the specified number of clocks.

The trigger filter is primarily intended for use with the internal clock, i.e. for asynchronous measurements, but will in fact operate with an external clock as well.

The trigger filter is always reset when the trigger sequence steps or restarts so that it is immediately able to start filtering in the new step. Refer to sections 5.6 and 5.8 for how to specify the trigger terms and trigger sequence itself.

Note that the 400MHz configuration has restricted trigger capabilities which exclude the use of a trigger filter. The trigger filter is therefore not an editable field when 400MHz INTernal clock is selected and shows <...>.

4.9. BRANCH FILTER

```
================================  =========  =========  =========  =========
          BRANCH FILTER
    OFF         INC         DEC
=========  =========  =========  =========  =========  =========  =========
```

Soft-key representation

The branch filter specifies how long the specified branch term must be present before it is accepted as a valid branch for the <else if> field of the trigger sequence. The time is specified as counts of the system clock; the default value is OFF (i.e. 1 clock) and the maximum count is 16 clocks. The branch filter is INCreased, starting at 2 clocks, by pressing the <INC> soft-key and DECreased by pressing the <DEC> soft-key; the <OFF> soft-key sets the restart filter to OFF.

Note that the 400MHz configuration has restricted branch capabilities which exclude the use of a branch filter. The branch filter is therefore not an editable field when 400MHz INTernal clock is selected and shows <...>.

5.1. INTRODUCTION

The Trigger menu, accessed by pressing the TRIGGER key, has four principle functions. The first is to set up the independent thresholds of the data pods; the second is to create the channel groups and assign them user-defined names; the third is to define up to 8 trigger words; lastly, the trigger sequence itself is constructed.

The Trigger menu and Configuration menu together permit all of the parameters to be set up for an acquisition.

Fig 5.1. shows the Trigger menu with its power-up default values (assuming the Configuration menu also has its default values) for an 80-channel instrument. For 48- and 32-channel instruments the Trigger menu displays only the appropriate number of pods and channels.

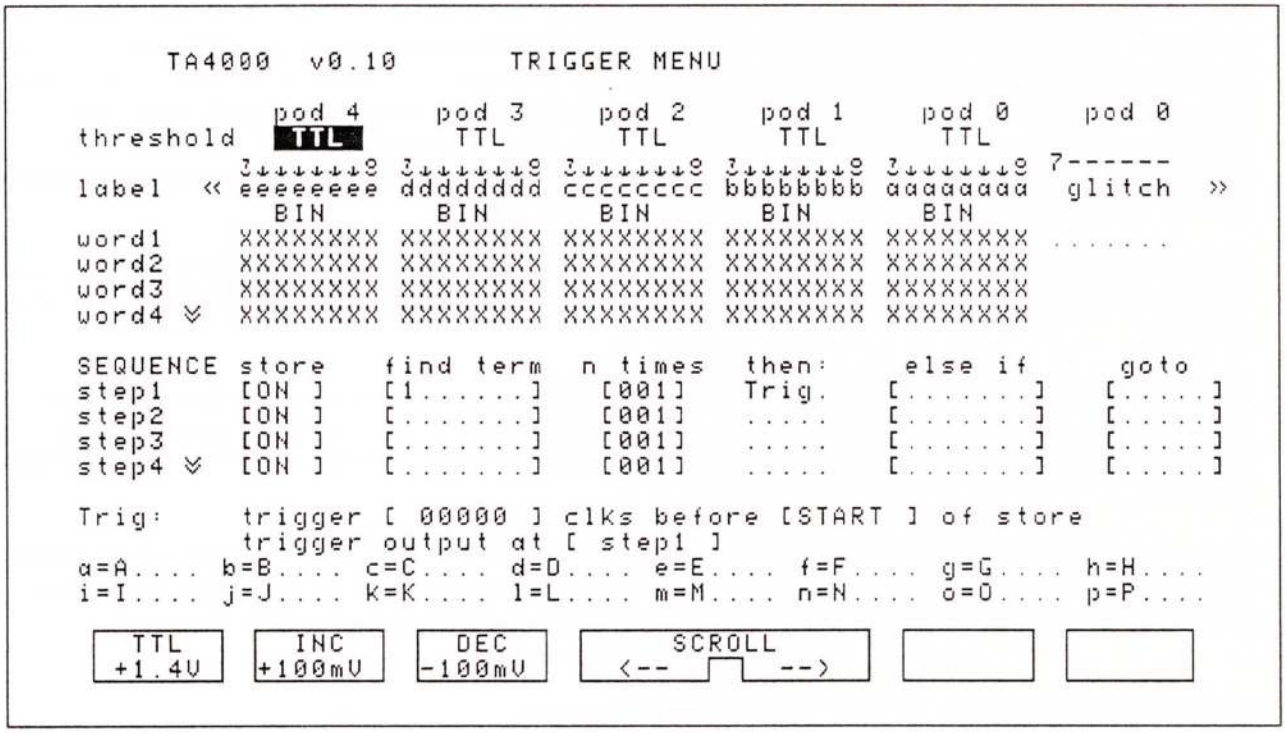

TA4000 v0.10 TRIGGER MENU
pod 4 pod 3 pod 2 pod 1 pod 0 pod 0
threshold TTL TTL TTL TTL TTL
label « eeeeeeee dddddddd cccccccc bbbbbbbb aaaaaaaa glitch »
BIN BIN BIN BIN BIN
word1 XXXXXXXX XXXXXXXX XXXXXXXX XXXXXXXX XXXXXXXX ....
word2 XXXXXXXX XXXXXXXX XXXXXXXX XXXXXXXX XXXXXXXX
word3 XXXXXXXX XXXXXXXX XXXXXXXX XXXXXXXX XXXXXXXX
word4 XXXXXXXX XXXXXXXX XXXXXXXX XXXXXXXX XXXXXXXX
SEQUENCE store find term n times then: else if goto
step1 [ON] [1.....] [001] Trig. [.....] [.....]
step2 [ON] [.....] [001] ..... [.....] [.....]
step3 [ON] [.....] [001] ..... [.....] [.....]
step4 [ON] [.....] [001] ..... [.....] [.....]
Trig: trigger [00000] clks before [START] of store
trigger output at [step1]
a=A.... b=B.... c=C.... d=D.... e=E.... f=F.... g=G.... h=H....
i=I.... j=J.... k=K.... l=L.... m=M.... n=N.... o=O.... p=P....
TTL +1.4V
INC +100mV
DEC -100mV
SCROLL <-- -->

fig 5.1

The revision of the installed software is displayed on the top line to the left of <TRIGGER MENU> until the first acquisition is run; the status of the current acquisition will be displayed in its place once the RUN key has been pressed. To the right of the title will be displayed editing prompts or warnings appropriate to the position of the edit zone and/or the acquisition currently in progress.

Below this line is the main part of the display where all the parameter fields can be set up. At the bottom are the soft-keys used when editing the display.

The Trigger menu is edited by moving the edit zone (reverse video block) to the parameter field of interest. The edit zone is moved around the visible editable parameter fields by the cursor keys as described in section 3.3.3. Additional channel groups and sequencer steps can be brought into view using the up/down and left/right scroll soft-keys as appropriate. Note that on some lines more than one field can be edited at a time, using the appropriate soft-keys, without extra cursor moves.

Acquisitions can be initiated and stopped from the Trigger menu but no parameters can be edited on the menu while the acquisition is running. If editing is attempted during an acquisition the warning message <no edit during acq> will be shown on the right-hand side of the top line of the display.

5.2. DATA POD THRESHOLDS

TTL	INC	DEC	SCROLL			
+1.4V	+100mV	-100mV	<--	-->		

Soft-key representation

With the edit zone in the <threshold> line of the display, the soft-keys are as shown above. Fig 5.1 shows the default position of the edit zone, i.e. in the threshold field for pod 4. The edit zone can be moved to the threshold fields of the other pods currently in view using the LEFT and RIGHT cursor keys; the remaining pods can be brought into the display using the left and right <SCROLL> soft-keys. The default threshold is <TTL>; the threshold can be INCreased or DECreased in 100mV steps using the <INC> or <DEC> soft-keys. The TTL compatible threshold can be set directly at any time using the <TTL> soft-key; a threshold of +1.4V is always shown as <TTL> in the parameter field regardless of whether it has been set by that key or by using the <INC> and <DEC> soft-keys. Similarly a threshold of -1.3V is always shown as <ECL> in the parameter field.

The threshold for all pods can be independently set in this manner to any value in the range -9.0V to +9.0V. the range of values 'wraps-round' such that increasing -9.0V, by a further step sets the threshold to 9.0V and increasing by a further step sets the value to -9.0V.

Immediately below the threshold fields are activity indicators for each channel. When the input to a channel is below the set threshold the indicator arrow points down; when it is above the set threshold the arrow points up. The indicators track the input state for low frequencies but for higher frequency signals the indicators will toggle at the rate at which the data is asynchronously sampled by the CPU, i.e. a few Hertz.

5.3. CHANNEL GROUP LABELS

	LABELS		SCROLL		CHARACTER	
CLEAR	DEFAULT	OFF	<--	-->	<--	-->

Soft-key representation

A channel group is any block of contiguous channels grouped together under one channel group label letter. A channel group may be from 1 to 32 channels wide and up to 16 different groups may be specified and labelled with the letters <a> through <p>.

A channel group may not be split, i.e. all channels used in the group must be adjacent. If a label is split whilst labelling the channels, the message <warning split label> will be shown in reverse video on the right-hand side of the top line of the display. The label will be accepted (and labelling can continue) but the warning will continue to be displayed, and it will not be possible to move the edit zone from this line, or run an acquisition, until the split label has been corrected.

Any letter <a> through <p> can be entered from the keyboard, using the SHIFT key for letters <g> through <p>. As each letter is entered, the edit zone automatically moves right to the next channel so that its label can be edited; the CHARACTER<-- and CHARACTER--> soft-keys can be used to move the edit zone channel-by-channel without disturbing the labelling of the channels the zone moves through. The RIGHT and LEFT cursor keys move the edit zone along the <label> line from its current position to the left-hand channel of an adjacent channel group.

The <CLEAR LABELS> soft-key can be used to clear all the channel groupings. Since clearing the labels in this way may cause a complex set-up to be lost, two presses of the <CLEAR LABELS> soft-key are required; after the first press the message <re-type to confirm> is displayed on the right-hand side of the top line of the display and the second press is required to actually implement the clear. Pressing any other key instead of the <CLEAR LABELS> soft-key a second time will maintain the existing label status and clear the warning message.

Pressing the <DEFAULT LABELS> soft-key sets the channel groupings to those shown in fig 5.1, i.e. label <a> for the 8 channels of pod 0, label <b> for pod 1, etc. Two presses of the <DEFAULT LABELS> soft-key are necessary to implement the change, as for <CLEAR LABELS>.

The <LABELS OFF> soft-key can be used to turn off individual channels in the Trigger menu (i.e. they are effectively set to 'don't care') and in the Timing and List display. However, the 'do care' settings of any trigger words using channels which have been turned off are not lost and will be restored when the channels are turned on again (by selecting any channel label). Note that turning channels off in the middle of a channel group will effectively split the channel label and the channels must be appropriately re-labelled before the edit zone can be moved from the <label> line or before an acquisition can be run.

Whenever << or >> show at the ends of the <label> field line, additional channel groups can be scrolled into view using the SCROLL<-- and SCROLL--> soft-keys respectively.

5.4. CHANNEL GROUP NAMES

CLEAR LABEL	SPECIAL CHARACTERS				CHARACTER	
	SPACE	/	*	?	<--	-->

Soft-key representation

Each of the 16 possible channel groups can be given a 5-character channel group name. These are defined by moving the edit zone to the two bottom lines of the display (immediately above the soft-keys) so that the names can be entered against the corresponding channel group label <a> through <p>.

The edit zone is moved by the RIGHT and LEFT cursor keys and the <CHARACTER> soft-keys exactly as for Channel Group Labels, section 5.3. With the edit zone positioned opposite a label, the name can be entered directly from the keyboard; any number or character can be used in the channel group name, including the four soft-key <SPECIAL CHARACTERS>, viz. <SPACE>, </>, <*> and </>. The <CLEAR LABEL> soft-key can be used to blank the name and allow it to be re-entered.

The default 'names' of the channel groups are the upper-case versions of the channel group labels themselves, i.e. <A> through <P> for labels <a> through <p>.

When more useful names are given to the channel groups (such as DATA, ADDR, CTRL, etc.) the channels in the trigger words still remain labelled with the single letters <a> through <p>; the two lines at the bottom of the display act, however, as a cross-reference for the user-defined names as well as being the means by which the names are given. On the List display (see section 7) the channels are default labelled with the single letter channel label as in the Trigger menu, but can be edited to display the channel group names. On the Configuration menu, only the single letter channel group labels are used, see section 4.7.2.4.

However, on the Timing display each channel is always labelled with the channel group name; in addition, where there is more than 1 channel in a group, the channels are automatically uniquely numbered. For example, if there are 8 channels in channel group <a> and the channel group name is <DATA>, the Timing display will show the 8 channels labelled as <DATA0> through <DATA7>. Note that, because the channel name is restricted to 5 characters **including** the automatically added numbers, 5-character names are truncated to 4 characters plus the number for groups of up to 10 channels and to 3 characters plus the number for channel numbers 10 and above. For example, a channel group of 16 channels with a channel name <DATA> will have their channels named on the Timing display as <DATA0> through <DATA9> and <DAT10> through <DAT15>.

5.5. TRIGGER WORD BASE SELECTION

	BASE		SCROLL			
BINARY	OCTAL	HEX	<--	-->		

Soft-key representation

Having grouped and labelled the data channels as required (section 5.3), the edit zone can be moved to the base parameter field; the soft-key change as shown above.

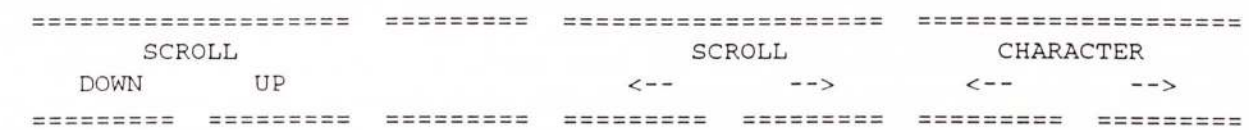
The base for each channel group can be independently set to the BINARY, OCTAL or HEXadecimal using the appropriate soft-key. The RIGHT and LEFT cursor keys are used to move the edit zone to each channel group in turn.

Whenever << or >> show at the ends of the <label> field line, additional channel groups can be scrolled into view using the SCROLL<-- and SCROLL--> soft-key respectively.

If X (don't care) is present in a trigger word when a base change is made then the corresponding bit or bits in the new base will be shown in one of the two following ways. Firstly, if an exact correspondence can be shown in the new base then X will appear in the appropriate bit(s); for example 1111XXXX(binary) will change to FX (hex) and vice-versa.

However, if there is no exact correspondence then an asterisk (*) will be displayed instead of an X; for example 1111111X (binary) will be shown as F* (hex) to indicate that at least 1, but not all, of the 4 least significant channels are don't care(s). Note that the original trigger word entry is always remembered in its original base; it is always used in that form within the analyser and can be displayed again by re-selecting that base. Thus 1111111X (binary) becomes F* (hex) becomes 1111111X (binary); however, if F* (hex) is edited to FX (hex) then this becomes 1111XXXX (binary).

5.6 TRIGGER WORD SPECIFICATION



Soft-key representation

The trigger words themselves can be specified by moving the edit zone into each channel group parameter field of the eight trigger words in turn. The trigger words are defined by entering characters from the keyboard consistent with the selected base of each channel group, viz. 0 and 1 for binary, 0 through 7 for octal and 0 through 9 plus A through F for hexadecimal. An X can be used to denote a 'don't care' in any of the three bases. If there is not an exact multiple of 3 channels in an octal group, or an exact multiple of 4 channels in a hex group then the 'incomplete' group will be the most significant bit in an appropriate base and the entries accepted in that bit will be restricted accordingly. Thus an 8-channel group can have a trigger word specified in hex between 00 and FF, but a 7-channel group with a hex base is restricted to entries between 00 and 7F.

The RIGHT and LEFT cursor keys move the edit zone along the <word> line from its current position to the left-hand channel of an adjacent one and the UP and DOWN cursor keys move the edit zone from one <word> to another. As each bit is specified in the appropriate base, the edit zone automatically moves right to the next trigger bit; when it gets to the last bit of a channel group the edit zone moves to the first bit of the next group to the right. The edit zone can also be moved to a particular position using the CHARACTER<-- and CHARACTER--> soft-keys without disturbing the trigger bits that the cursor moves through.

In 400MHz mode all pods except pod 0 (plus pod 6 on the 80-channel version) are disabled; similarly pod 9 is disabled on the 80-channel version when glitch is ON. Channels disabled for these reasons are suppressed on the Timing and List displays for clarity; however, all channels are still shown on the Trigger menu, but the disabled channels are indicated by replacing their channel numbers (above the group labels) with <.....>, see figs 5.2 and 5.3.

Whenever << or >> show at the ends of the label field line, additional channel groups can be scrolled into view using the SCROLL<-- and SCROLL--> soft-keys respectively. Only 4 words are displayed on the Trigger menu at the same time; the presence of the additional words is indicated by the arrowed up and arrowed down signs next to the <word n> column and these can be brought into view by using the <SCROLL up> and <SCROLL down> keys respectively.

5.7 GLITCH TRIGGERING

If <glitch ON> has been selected in the Configuration menu then the Trigger menu changes to allow the edit zone to be moved into the extension field of <word 1> labelled <glitch>, see fig 5.2.

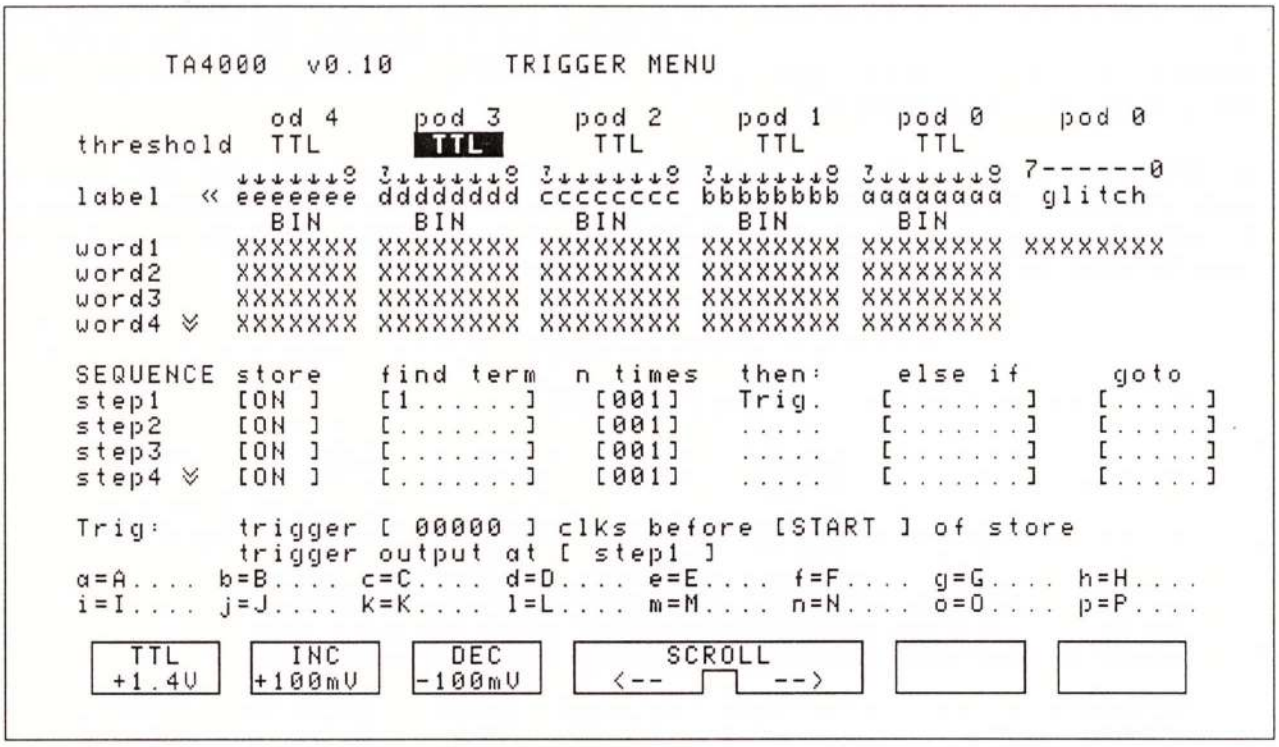

TA4000 v0.10 TRIGGER MENU
od 4 pod 3 pod 2 pod 1 pod 0 pod 0
threshold TTL TTL TTL TTL TTL
label « eeeeeee ddddddd ccccccc bbbbbbb aaaaaaa glitch
BIN BIN BIN BIN BIN
word1 XXXXXXX XXXXXXXX XXXXXXXX XXXXXXXX XXXXXXXX XXXXXXXX
word2 XXXXXXX XXXXXXXX XXXXXXXX XXXXXXXX XXXXXXXX
word3 XXXXXXX XXXXXXXX XXXXXXXX XXXXXXXX XXXXXXXX
word4 XXXXXXX XXXXXXXX XXXXXXXX XXXXXXXX XXXXXXXX
SEQUENCE store find term n times then: else if goto
step1 [ON] [1.....] [001] Trig. [.....] [.....]
step2 [ON] [.....] [001] ..... [.....] [.....]
step3 [ON] [.....] [001] ..... [.....] [.....]
step4 [ON] [.....] [001] ..... [.....] [.....]
Trig: trigger [00000] clks before [START] of store
trigger output at [step1]
a=A.... b=B.... c=C.... d=D.... e=E.... f=F.... g=G.... h=H....
i=I.... j=J.... k=K.... l=L.... m=M.... n=N.... o=O.... p=P....
TTL +1.4V
INC +100mV
DEC -100mV
SCROLL <-- -->
CHARACTER <-- -->
GLITCH ON OFF

fig 5.2

If <glitch OFF> has been selected on the Configuration menu then <.....> will be shown in the <glitch> field to show that it is inactive.

With the edit zone in this field the soft-keys change to:

GLITCH		SCROLL		CHARACTER	
ON	OFF	<--	-->	<--	-->

Soft-key representation

Pressing the <GLITCH ON> key enters a <G> on the glitch channel where the edit zone is positioned and automatically steps the cursor to the next channel; pressing <GLITCH OFF> enters an X (don't care); G and X can also be entered directly from the keyboard. The CHARACTER--> and CHARACTER<-- soft-keys can be used to move the edit cursor through the field without affecting the bits already set.

The <glitch> trigger word is the ORed combination of any glitches specified. The word itself is an extension of trigger word 1, i.e. the ORed combination of glitches is ANDed with trigger word 1.

5.8 SPECIFYING THE TRIGGER SEQUENCE

5.8.1. Introduction

The remaining area of the Trigger menu below the trigger words (and above the channel group label/name reference list) is devoted to the trigger sequencer itself. Only 4 of the available branching steps are displayed at the same time; the presence of additional steps is indicated by the arrowed up and down signs next to the <step n> column and these can be brought into view using the <SCROLL up> and <SCROLL down> keys respectively. The eighth, trigger position, step is always displayed.

In 400MHz mode only the < find term > of step 1 is available and the term can only consist of 1 trigger word; to indicate this the unavailable parameter fields are shown as blanks and editing is not possible in them, see fig 5.3 (the Trigger menu in 400MHz mode) cf. fig 5.2.

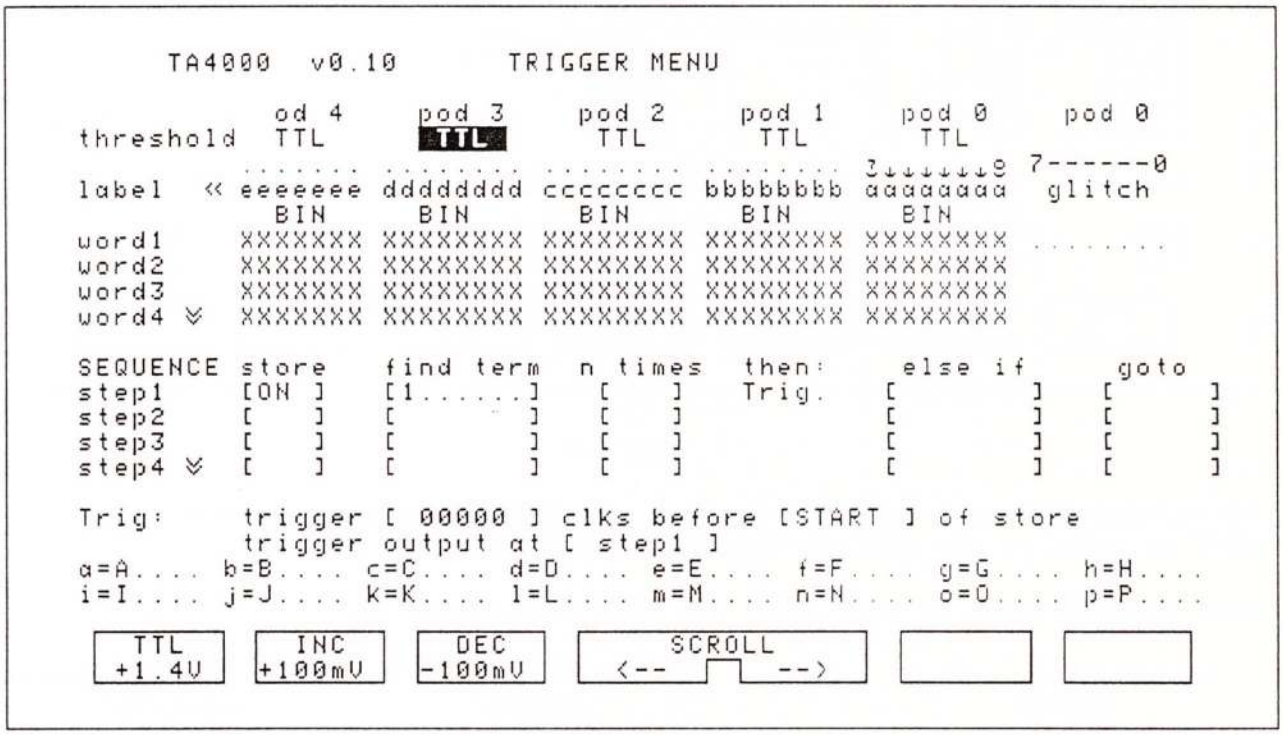

TA4000 v0.10 TRIGGER MENU
od 4 pod 3 pod 2 pod 1 pod 0 pod 0
threshold TTL TTL TTL TTL TTL
label « eeeeeee ddddddd ccccccc bbbbbbb aaaaaaa glitch
BIN BIN BIN BIN BIN
word1 XXXXXXX XXXXXXXX XXXXXXXX XXXXXXXX XXXXXXXX
word2 XXXXXXX XXXXXXXX XXXXXXXX XXXXXXXX XXXXXXXX
word3 XXXXXXX XXXXXXXX XXXXXXXX XXXXXXXX XXXXXXXX
word4 XXXXXXX XXXXXXXX XXXXXXXX XXXXXXXX XXXXXXXX
SEQUENCE store find term n times then: else if goto
step1 [ON] [1.....] [ ] Trig. [ ] [ ]
step2 [ ] [ ] [ ] [ ] [ ]
step3 [ ] [ ] [ ] [ ] [ ]
step4 [ ] [ ] [ ] [ ] [ ]
Trig: trigger [00000] clks before [START] of store
trigger output at [step1]
a=A.... b=B.... c=C.... d=D.... e=E.... f=F.... g=G.... h=H....
i=I.... j=J.... k=K.... l=L.... m=M.... n=N.... o=O.... p=P....
TTL +1.4V
INC +100mV
DEC -100mV
SCROLL <-- -->

fig 5.3.

The sequencer has 7 branching steps followed by an eighth (Trig) step in which the trigger position and trigger output are specified. Each branching step consists of selecting data storage to be ON or OFF on entry to the step, specifying the trigger term to be found plus the number of times it must be found, and specifying the branching (else if) term together with the step the sequencer must branch to if the <else if> term is found. In the eighth step the trigger can be positioned up to 60,000 clocks before the start, centre (50%) or end of store; the trigger out signal can also be specified to be output on any sequencer step.

5.8.2. Storage Qualification

SCROLL		STORAGE				
DOWN	UP	ON	OFF			

Soft-key representation

With the edit zone in the <store> field of any of the 7 branching sequencer steps, the soft-keys are as shown above.

Data storage can be selected to be on or off for the duration of a sequencer step using the <STORAGE ON> and <STORAGE OFF> soft-keys. Note that data will not be stored on any clock(s) occurring within 55ns of the clock which determines entry into a step with storage <ON> from a step with storage <OFF>; similarly data will continue to be acquired on clock(s) within 55ns of exit from a step with storage <ON> to a step with storage <OFF>. This small delay in the actual data qualification has no effect on the trigger sequencer operation itself, which operates as specified up to 100MHz clock rates.

5.8.3. The Find Term

SCROLL		EDIT TERM			TERM	
DOWN	UP	INC >	WORD(1)	CLEAR	NOT(*)	TRUE

Soft-key representation

With the edit zone in the <find term> of any of the 7 branching sequencer steps, the soft-keys are as shown above.

The <find term> can be any ORed combination of upto 4 of the 8 trigger words defined in the top part of the trigger menu; an <X> can also be entered to make the term don't care and the whole term can be specified to be NOTed, i.e. <NOT TRUE>.

Trigger words are added or deleted from the <find term> over which the edit zone is positioned by alternate presses of keys 1 through 8 (for <word 1> through <word 8>) or X on the keyboard. The trigger words will always be shown in numerical order in the <find term>, regardless of the order in which they have been entered. Trigger words can also be added or deleted using the <EDIT TERM> soft-keys; the <INC> soft-key is used to INCrement the <WORD (n)> soft-key to the appropriate word and the <WORD (n)> soft-key can then be used to add or delete that word to the find term with alternate presses. Leaving unused steps in the sequencer, e.g. by entering trigger terms in steps 1 and 4 but not in steps 2 and 3, will cause a lower-case <x> to appear in the "unused" steps. <x> indicates a default don't care condition and is automatically entered to ensure a sensible sequencer construction; the <then> field also automatically fills with the appropriate next step number for the same reason. Note that every step with a don't care requires an additional clock to steps through it.

The <CLEAR> soft-key is an alternative, quicker, way of clearing all words from the term. A step at the end of a sequencer will revert to [.....] (i.e. be disabled) when cleared in this way but an intermediate step will be cleared to [x.....], where the lower-case <x> indicates a default don't care inserted to maintain the overall sequencer construction; this <x> don't care is functionally identical to the <X> don't care which can be inserted deliberately by the user. Similarly, clearing the <find term> in step 1 (whether there are other steps or not) will cause the default <x> don't care to be shown so that a usable sequence construction is preserved.

The whole term can be set to be NOT true using the <NOT(*)> soft-key, or reset to true using the <TRUE> key; the <*> in front of the bracketed find term indicates that the term is NOTed. Using a NOT term permits triggering on anything except the specified words.

In 400MHz mode only 1 word is accepted in the <find term> of the first step and all other steps are ignored. If a more complex sequence has been constructed prior to setting the internal clock to 400MHz (on the Configuration menu) then only the lowest numbered trigger word will be shown in the <find term> of the first step and all other step entries will be suppressed; however, the full sequencer construction is restored when 400MHz mode is deselected.

The <then> field shows the step to which the sequencer will go when the <find term> is found the correct number of times (see also 5.8.4). This is not an editable field but is filled in automatically as the sequence is constructed in order to make it understandable to read. The last (or only) step used will have <Trig> in the <then> field, i.e. the sequencer will step to the eighth (Trigger) step when that <find term> is satisfied. Other steps will be automatically filled with the next step number, i.e. the <find term then> fields form a consecutive step sequencer regardless of whether the <else if goto> fields have entries (see also 5.8.5).

5.8.4. Trigger Event Delay

	SCROLL		EVENT DELAY			
DOWN	UP	INC	DEC	N=1		

Soft-key representation

Moving the edit zone to the <n times> field in any of the sequence steps gives the soft-key display shown above. The number of times that the trigger term must be found (before the sequencer is incremented to the next step defined by the <then> term) is set in this field.

Up to 256 counts of the trigger term can be specified, either by using the <INC> and <DEC> soft-keys or (more quickly for larger counts) by direct decimal entries from the keyboard. If a count of 0 or greater than 256 is entered from the keyboard, a warning message <illegal value> is displayed at the right-hand side of the top line of the display; the edit zone cannot be moved out of this field until a legal value is entered.

Keyboard entries are made 'calculator-style' as described more fully in section 4.7.2.3. The count can always be returned to its minimum value (001) by pressing the <N=1> soft-key.

The event count operates differently for internal and external clock. With internal clock the first event is recognised when the trigger term has been present for the number of clock samples specified for the trigger filter, see section 4.8; before the next event can be recognised, however, the trigger term must go away, i.e. not be recognised, for at least 1 clock and must then be present for the number of clock samples specified for the trigger filter. With external clock, the first event is recognised when the trigger filter is satisfied, as before. However, if the trigger term is still present at the next clock, this becomes the first trigger filter clock count of the next event; if there are sufficient clocks to satisfy the trigger a second time then a second event is recognised and so on.

For example, if the trigger filter is OFF (i.e. defaulted to 1 clock) and a trigger term is present for 5 consecutive clock periods then this is recognised as 1 event in internal clock mode but could be recognised as 5 events in external clock mode; with the trigger filter set to 2 clocks, the same trigger term is seen as 1 event in internal mode and 2 events in external clock mode.

No event count is available in 400MHz mode; to indicate this, [...] is displayed in the <n times> field of step 1 (the only usable step).

5.8.5. The Else If (Branching) Term

SCROLL			EDIT TERM		TERM	
DOWN	UP	INC>	WORD(n)	CLEAR	NOT(*)	TRUE

Soft-key representation

With the edit zone in the <else if> field of any of the 7 branching sequence steps, the soft-keys are as shown above.

The <else if goto> fields add a full conditional branching capability to the sequencer; the <goto> field specifies where the sequencer will branch to if the <else if> term is recognised before, or at the same time, as the <find term n times> is satisfied. The <else if> term can be any ORed combination of up to 4 of the 8 trigger words defined in the top part of the Trigger menu; an <X> can also be entered to make the term don't care and the whole term can be NOTed, i.e. <NOT TRUE>. Trigger terms are added or deleted from the <else if> term via the keyboard or <EDIT TERM> soft-keys exactly as for the <find term>, see 5.8.3. The one exception is that <CLEAR> actually clears all the terms from the <else if> field, i.e. it disables the field, since a default of <x> (don't care) is not meaningful in this part of the sequencer.

When the <else if> term is recognised the sequencer branches to the step specified by the <goto> field, see 5.8.6.

Steps without a <find term> or outside the range of the highest numbered <goto> step, i.e. beyond the step containing <Trig> in its <then> field, may contain trigger words in their <else if> fields but these will be ignored in the sequencer operation.

5.8.6. Goto

SCROLL		BRANCH TO				
DOWN	UP	INC	DEC	TRIG		

Soft-key representation

With the edit zone in the <goto> field of any of the 7 branching sequencer steps, the soft-keys are as shown above.

The <goto> field specifies the step to which the sequencer will branch when the <else if> term is recognised. The default entry is <step 1> whenever an entry is made to the corresponding <else if> field; no step is shown, and no step can be entered in the <goto> field until the <else if> term is present.
The <goto> entry can be changed from the default value of <step 1> using the <INC> or <DEC> soft-keys or by direct keyboard entry of <1> through <8> for <step 1> through <step 7> and <Trig> respectively. The <TRIG> soft-key can also be used to directly enter <Trig>.

If a higher step number is entered into the <goto> field than currently has a trigger word in its <find term> field default don't care(s) (<x>) are entered into the <find term> fields of that (and intermediate) step(s) which don't have specified trigger words, to ensure that a valid sequence is maintained. At the same time the <then> field automatically shows <Trig> in the highest numbered step, and the "next step" number in all the preceding steps, for the same reason. Note, however, that entering <Trig> in the <goto> field does not cause this to happen even though the <Trig> step is effectively <step 8>. Note also that every step with a don't care find term still requires a clock to step through it.

As noted in 5.8.5., steps without a <find term> entry or outside the range of the highest numbered <goto> step, i.e. beyond the step containing <Trig> in its <then> field, may contain trigger words in their <else if> fields and step numbers in their <goto> fields but these will be ignored in the sequencer operation.

5.8.7. Trigger Position

TRIGGER DELAY				BEFORE		
INC	DEC	ZERO		START	50%	END

Soft-key representation

Moving the edit zone down from the last displayed sequence step into the trigger position fields enables both the clock count and the reference position to be entered using the soft-keys shown above.

The power-up default condition is 00000 clocks before the start of store; the trigger word is put in store location 0000 and the store is filled with the samples following the trigger word. This set-up ensure that a complete store-full of data is acquired even if the trigger words are all don't care.

If the trigger position is selected to be 00000 clocks before the end of store by pressing the <BEFORE END> soft-key then the trigger word is positioned at the end of the stored data. Note that if the trigger word is recognised within the specified store depth then the store will not be completely filled; the first store location will contain the first sample of data acquired after pressing RUN and the last stored sample will be the trigger word. An extreme example of this is if the trigger is recognised immediately the acquisition is initialised; the store will be empty except for the trigger word positioned at the first location.

Similarly, if the trigger position is selected to be 00000 clocks before the centre of store by pressing the <BEFORE 50%> soft-key then the trigger word is positioned half the store before the last stored sample; if the trigger is recognised within half the store of initiating the acquisition then the second half of the store will be correspondingly partly empty.

It is possible to position the trigger anywhere in the store by additionally using the clock delay count. For example, setting the trigger position to be 01023 clocks before the end of store will put the trigger word in store location 0000 and fill the store (if a 1k store depth has been selected); setting the position to be 01000 clocks before the end of store will put the trigger word in location 0023 (providing the trigger wasn't recognised within the first 23 samples) and fill the store with the following 1000 samples. The trigger position can also be specified to be before the start of store by using a clock count of up to 60000.

The trigger delay clock count is INCreased or DECreased using the <INC> or <DEC> soft-keys; it can also be specified by direct decimal entries from the keyboard. If a count greater than 60000 is entered from the keyboard, a warning message <illegal value> is displayed at the right-hand side of the top line of the display; the edit zone cannot be moved out of this field until a legal value is entered. Decimal entries from the keyboard are made 'calculator-style' as described in section 4.7.2.3.

The count can always be returned to its default value of 00000 by pressing the <ZERO> soft-key.

The delay count is exact for clock frequencies up to 50MHz and +/-20ns for 100MHz and 400MHz counts.

5.8.8. Trigger Output

```
  ====================  =========  =========  =========  =========  =========
      TRIG OUTPUT
    INC          DEC
  =========  =========  =========  =========  =========  =========  =========
```

Soft-key representation

Moving the edit zone down into the last line of the sequencer (immediately above the channel label/name cross-reference list) enables the trigger output point to be specified using the soft-keys shown above.

The trigger output signal can be specified to occur on entry to any step, i.e. <step 1> through <step 7> or <Trig>, using the <INC> and <DEC> soft-keys to INCrement or DECrement through the steps. Alternatively, the step number can be directly entered from the numeric keyboard.

The trigger output signal is a TTL level signal at the rear panel BNC connector which goes high as the specified step is entered, i.e. before the delay count in the case of the <Trig> step; it goes low again on exit from the specified step.

6.1. INTRODUCTION

The Timing display is accessed by pressing the TIMING key.

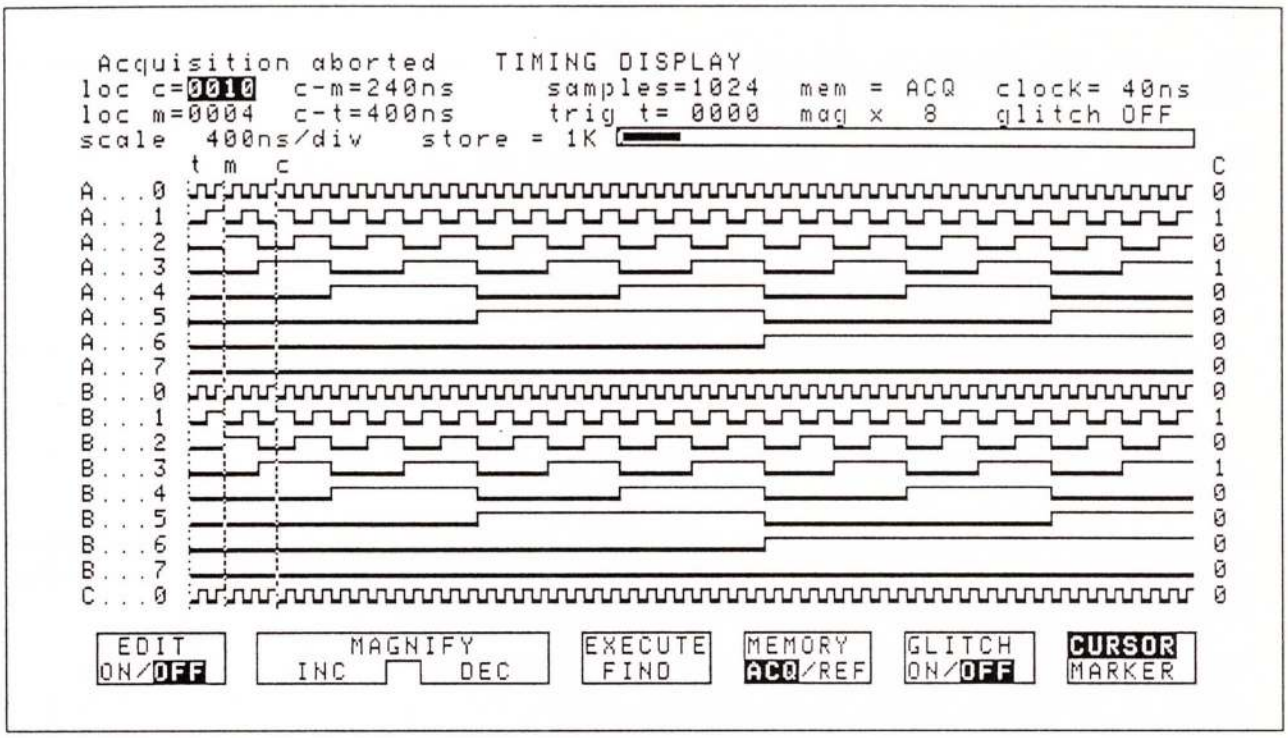


fig 6.1.

There are 3 distinct areas of the display. At the top of the screen, below the display title, are 3 lines of information; these contain details of the conditions under which the data was captured (clock rate, glitch ON or OFF, etc.) and information concerning the manipulation of the data in the store (readout of cursor positions, indication of magnification, etc). On the top line, to the left of the title itself will be displayed the current status of the acquisition once the RUN key has been pressed; to the right of the title will be displayed editing prompts or messages appropriate to the position of the edit zone (during edit) and/or the acquisition currently in progress.

Below the information area are 17 lines for the display of data channels, busses, and/or scale; channels, busses, and scale can be displayed and repeated in any order. Any channel can be brought into view, either by scrolling it into the display with the UP and DOWN cursor keys, or by direct editing. To the left of each displayed line is the name of the channel; this is either the user-defined channel group name or the default channel group label, see sections 5.3 and 5.4.

Striking vertically through the 17 lines of data are a movable cursor and marker, and a fixed trigger marker; the cursor, marker, and trigger marker are themselves marked <c>, <m> and <t> respectively at the top of the vertical lines, above the first line of timing data. Either the cursor or marker may be designated active at any one time, i.e. made movable by the arrowed RIGHT and LEFT cursor keys.

Magnification of the data by up to x16 is possible; magnification is always about the cursor, <c>. A graphical representation of the store area currently being displayed is shown in the third information line above the data area.

Down the right-hand side of the data area is a column of characters, one character for each line of waveform data.
This column can be selected to give a readout of the cursor, marker or trigger positions, or can be used to specify a FIND word used in a search of the Timing display.

At the bottom of the screen are the soft-keys. Fig 6.1 shows a typical display with the EDIT condition set to OFF; with EDIT set to ON, the soft-keys change with the position of the edit zone, as in the menu displays.

Acquisitions can be initiated and stopped from the Timing display and the display can be manipulated while the acquisition is running although the speed of operation will generally be slower.

6.2. ACQUISITION PARAMETERS SHOWN IN THE TIMING DISPLAY

The most important parameters associated with an acquisition are shown in the information lines below the display title. These are:

<samples=> the number of valid samples in the store

<trig t=> the store location of the trigger word. If the trigger was outside of the store then this is shown as <trig t=????>

<clock=> the period of the internal clock used for the acquisition, or <EXT> if an external clock was selected.

<glitch> ON or OFF as selected in the Configuration menu before the acquisition was taken

<store=> the store depth selected on the Configuration menu (see section 4.5) and which is represented by the outer box of the graphical representation of the store to the right. See section 6.6 for more details.

Note that the values of the parameters shown are those relating to the acquisition of the data memory currently being displayed. If the parameters are changed on the Configuration menu, they will not change on the Timing display until an acquisition has been made with those parameters and the results displayed on the Timing display.

The other parameters shown in the information lines relate to the data as it is currently displayed, viz. cursor and marker store locations, magnification factor, etc.; these are explained in the following sections.

6.3. ACTIVE CURSOR/MARKER SELECTION AND MOVE

EDIT ON/OFF	MAGNIFY INC	MAGNIFY DEC	EXECUTE FIND	MEMORY ACQ/REF	GLITCH ON/OFF	CURSOR MARKER

Soft-key representation

Either the cursor or marker is selected to be active at any one time with alternate presses of the <CURSOR/MARKER> soft-key; the one currently active is indicated by displaying it in reverse video within the soft-key itself. Only the one currently active can be moved by the RIGHT and LEFT cursor keys or by direct entries from the keyboard. Moving the cursor and marker on the Timing display also moves them on the List display.

The information lines at the top of the display give the cursor and marker absolute store locations in the fields <loc c=> and <loc m=> respectively.

The one currently active has its 'absolute location' field shown in reverse video and direct numeric entries can be made to this field to move the cursor/marker quickly. Keyboard entries are made 'calculator-style', i.e. store location 1000 is entered as 1,0,0,0; each entry appears in the least significant position and increments the previous entry to the next significant digit on the left. Four key entries fill the field and on the fourth entry the cursor/marker is moved to the specified location; the next entry is then interpreted as the first digit of a new location. To move to a low-numbered location the entry can either be made as, for example, 0,0,2,1, so that the move is made on the fourth (1) entry key press, or it can be entered by pressing 2,1,X, where X terminates the entry and causes the cursor/marker to move. High numbers, outside the range of the currently selected store depth, are accepted but the cursor will only move to the highest location in the store.

Note that, when the active cursor/marker is being moved with the RIGHT and LEFT cursor keys, the cursor/marker initially moves slowly but then speeds up if the key is kept depressed; releasing the key and pressing again (as the cursor/marker approaches the desired location) moves it slowly once more.

It is also possible to move the marker directly to the cursor position when edit is ON, see section 6.7.

6.4. ACQUISITION/REFERENCE MEMORY SELECTION

EDIT ON/OFF	MAGNIFY INC	MAGNIFY DEC	EXECUTE FIND	MEMORY ACQ/REF	GLITCH ON/OFF	CURSOR MARKER

Soft-key representation

The memory whose contents are to be displayed is selected with alternate presses of the <MEMORY ACQ/REF> soft-key; the currently active memory is shown in reverse video within the soft-key itself.

The acquisition memory is the memory in which the most recently acquired data is stored.

The reference memory may have been loaded from the previous acquisition or any earlier acquisitions saved in non-volatile memory, see section 8.3.

6.5. GLITCH DISPLAY

EDIT ON/OFF	MAGNIFY INC	MAGNIFY DEC	EXECUTE FIND	MEMORY ACQ/REF	GLITCH ON/OFF	CURSOR MARKER

Soft-key representation

If the data being displayed was acquired with glitch selected on the Configuration menu (see section 4.4.), then the <glitch> field in the second information line at the top of the display will show <ON>. Alternate presses of the <GLITCH ON/OFF> soft-key will then turn the display of glitches on or off; the current status of the glitch display is shown by displaying <ON> or <OFF> in reverse video within the soft-key itself.

Glitches are shown on the display as vertical lines extending both above the logical '1' level and below the logical '0' level. As a reminder that only the channels pod 0 are glitch channels, these are marked with a lower-case <g>

following their channel group name at the left-hand side of the data line.

6.6. DISPLAY MAGNIFICATION AND SCALE

EDIT ON/OFF	MAGNIFY INC	MAGNIFY DEC	EXECUTE FIND	MEMORY ACQ/REF	GLITCH ON/OFF	CURSOR MARKER

Soft-key representation

The display magnification can be INCreased and DECreased from x1 to x16 in multiples of 2 using the <INC> and <DEC> soft-keys. The range of values 'wraps-round' so that INCreasing the magnification by a further step when it is already at x16 will set it to x1, and DECreasing the magnification by a further step when it is already at x1 will set it to x16; this can be used to get from minimum to maximum magnification very quickly, and vice-versa. The current magnification factor is always shown in the <mag x> field in the second information line at the top of the display.

In the third information line there is also a graphical representation of the area and 'depth' of the currently displayed data. The whole store is defined by the outline of the box beside the <store=> field and the extent and position of the currently displayed data is shown by the reverse video block within the box. The trigger marker, t, is also permanently shown by a line descending from the top of the box, and the marker, m, is shown by a line rising from the base of the box; the cursor, c, is never shown in this box because it is always within the data displayed. Note that, since only 1k samples can be displayed at once, the reverse video block indicates that only 1/2 or 1/8 of the store is currently being displayed for 2k or 8k store depths respectively, even with the magnification at x1.

As the magnification changes, so does the calibration of the scale line of the display. The time represented by the distance between the larger divisions of the scale for the current display are shown in the <scale> field in the third information line at the top of the display. If the displayed data was acquired with the internal clock then the scale is calibrated in time per division; if an external clock was used then it is calibrated in clocks per division.

6.7. DATA SEARCHING IN THE TIMING DISPLAY

EDIT ON/OFF	MAGNIFY INC	MAGNIFY DEC	EXECUTE FIND	MEMORY ACQ/REF	GLITCH ON/OFF	CURSOR MARKER

Soft-key representation

A search for the specified <FIND WORD> can be made at any time by pressing the <EXECUTE FIND> soft-key. If the word is found, the cursor will move to that store location; subsequent presses of the <EXECUTE FIND> soft-key will move the cursor to the next higher store location at which the word is found, and so on until the end of the store is reached.

To set up the <FIND> word the <EDIT ON/OFF> key must first be pressed to select the edit mode; the edit status is shown by displaying <ON> or <OFF> in reverse video within the soft-key itself.

With edit <ON> the edit zone (reverse video block) can now be moved with the RIGHT cursor key to the <CURSORS/FIND TERM> character column on the extreme right of the display; the soft-keys then change to those shown below:

EDIT ON/OFF	SET MARKER	EXECUTE FIND	CURSORS/FIND WORD			
			FIND	CURSOR	TRIGGER	MARKER

Soft-key representation

The <CURSORS/FIND WORD> soft-keys are used to select the function of this column, viz.

<FIND> : column becomes the <FIND WORD> and binary entries can be specified from the keyboard; as each entry is made the edit cursor automatically moves down to the next line. The edit cursor can also be moved up and down the column by the arrowed UP and DOWN cursor keys. If glitch display is on (see section 6.5) then the <FIND WORD> can also be specified to search for glitches by entering G instead of 0, 1 or X in the <FIND WORD> bits of the glitch channels.

The search is made across all channels currently turned on in the Timing display (see section 6.8.), not just those currently in view. When the channel order is edited the <FIND WORD> bit moves with its associated channel. A search can be initiated without the <FIND WORD> being displayed.

<CURSOR> : column becomes the readout, in binary, of the store contents at the location of the cursor <c>.

<TRIGGER> : column becomes the readout, in binary, of the trigger word.

<MARKER> : column become the readout, in binary, of the store contents at the location of the marker <m>.

Pressing the <FIND> soft-key therefore enables the search word to be entered in the <FIND WORD> column in the manner specified above.

The search can also be initiated with the edit <ON> and the edit zone in the <CURSORS/FIND WORD> field by pressing the <EXECUTE FIND> soft-key.

One further feature available with the edit zone in this position is that the marker <m> can be set to the same store location as cursor <c> by pressing the <SET MARKER> soft-key.

6.8. EDITING THE TIMING DISPLAY

EDIT ON/OFF	MORE>>	EDIT LABELS				
		INSERT	DELETE	DEFAULT	NEXT	PREV

Soft-key representation

The default order in which the data channels are displayed at power up is channel 0 through channel 7 of pod 0, 1,2 etc. in ascending pod order; channel 0 of pod 0 is the top data channel and channel 7 of the highest numbered pod is the last data channel. The default position of the scale is in the line after the last channel.

The data channels and scale can, however, be repeated and displayed in any order. To change the display to a user-defined order it is first necessary to switch edit <ON> by pressing the <EDIT ON/OFF> soft-key; the soft-keys will change to those shown above.

The edit status is shown by displaying the <ON> or <OFF> in reverse video within the soft-key itself; edit can be switched <OFF> again by a second press of the <EDIT ON/OFF> soft-key and the soft-keys will change back to those of section 6.3.

With edit selected to be <ON> the edit zone will be positioned over the channel name of the first line of data; if the Timing display has already been edited (e.g. for the <find term>) then it may be necessary to bring the edit zone back to the channel name column by pressing the LEFT cursor key. The edit cursor can be moved up or down the column of channel names with the UP and DOWN cursor keys. When the edit zone has been moved to the bottom data line, further presses of the DOWN key will scroll the data lines up the display and the edit zone will remain in the bottom line; scrolling will stop when the channel or scale on the last line are brought into view. Similarly, when the edit zone is at the top data line, further presses of the UP key will scroll the data lines down the display until the first data line is brought into view.

With the edit zone positioned over a channel name, the six <EDIT LABELS> soft-keys have the following functions:

<MORE> offers two further edit functions of <SCALE> and <BUS> in place of <INSERT> and <DELETE>; a second press of <MORE> returns the original <EDIT LABELS> soft-key choice.

<DEFAULT> returns the channel order to the default setting described earlier. Pressing <DEFAULT> once causes the warning message <retype to confirm> to be displayed in reverse video at the right- hand side of the top line of the display; it is necessary to press it a second time to implement <DEFAULT>. Pressing any other key instead of a second press of <DEFAULT> will prevent the default from being implemented.

<DELETE> deletes the data channel over which the edit zone is positioned; all the channels below that line are immediately scrolled up one position and the edit zone therefore effectively becomes positioned over what was the next data channel.

<NEXT> changes the data channel displayed at the edit zone position to the next data channel in the default channel order, e.g. if the edit zone is at channel 6 of pod 0, the data channel will change to channel 7 of pod 0, then channel 0 of pod 1, etc.

<PREV> changes the data channel displayed at the edit zone position to the previous data channel in the default channel order, e.g. if the edit zone is at channel 6 of pod 0, the data channel will change to channel 5 of pod 0, then channel 4 of pod 0, etc.

<INSERT> scrolls all the data channels below the edit zone down 1 line with each press. The line is left blank until either a scale is inserted by pressing <SCALE> or a data channel is inserted using the <NEXT> and <PREV> keys. If the <NEXT> key is the first key pressed after <INSERT> then channel 0 pod 0 will be inserted and further presses of <NEXT> will increment the line forward through all the channels in their default order as described for <NEXT> above. If the <PREV> key is the first key pressed after <INSERT> then the scale will be inserted and further presses of the <PREV> key will decrement the line back through all the channels in their reverse default order as described for <PREV> above.

<SCALE> **replaces** the data channel at the current edit zone position by scale; a scale can also be **inserted** by using <INSERT> followed by <SCALE>.

<BUS> **replaces** the data channel at the current edit zone position by a 'bus' showing the activity of **all** the channels in the group to which that channel belongs. For example, with the default channel group labelling, pressing <BUS> with the edit zone over any of the channels A0 through A7 will replace that channel with a bus display of all those channels. As a reminder that it is a bus being displayed a <b> is shown beside the channel group name. If a bus is required in addition to all channels of the group it will first be necessary to INSERT any channel of the group and then replace that extra channel by the bus.

Note that there is effectively an extra line which is a 'blank'; if the display line is incremented with the <NEXT> key through all possible channels and scale, a further press of <NEXT> will make the line blank; one more press will bring channel 0 of pod 0 into view, etc. Similarly, pressing <PREV> with the edit zone over channel 0 of pod 0 will make the line go blank and another press will bring scale into view, etc.

In 400MHz the unavailable channels are automatically suppressed on the Timing display. Similarly, when an acquisition has been made with glitch ON the unavailable channels are automatically suppressed. The channels that are available when a configuration is changed will be shown in whatever position in the Timing display they were last edited into.

Section 7 - List Display

7.1. INTRODUCTION

The List display is accessed by pressing the LIST key.

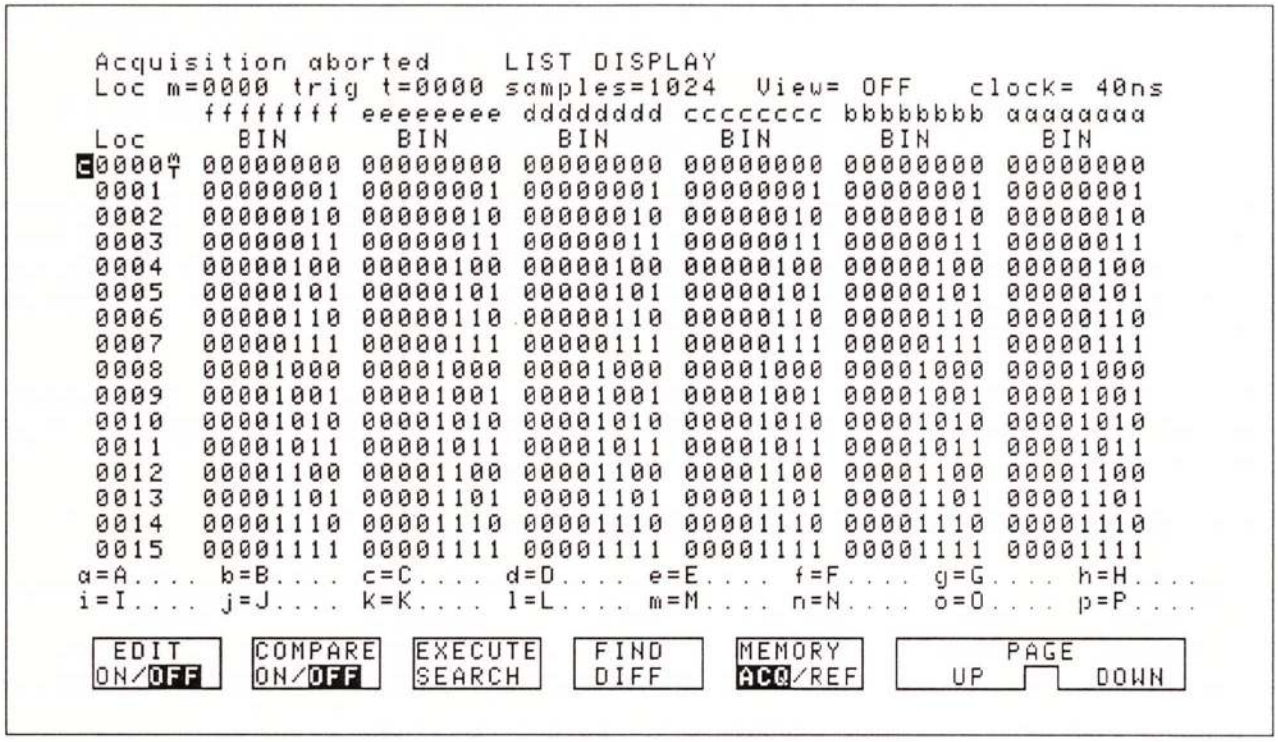


fig 7.1.

At the top of the screen, below the display title, is an information line giving the essential details of the conditions under which the data was captured. On the top line, to the left of the title itself will be displayed the current status of the acquisition once the RUN key has been pressed; to the right of the title will be displayed editing prompts or messages appropriate to the position of the edit zone (during edit) and/or the acquisition currently in progress.

Below this is listed the data from 16 consecutive store locations; the numbers of the store locations are listed beneath the heading <Loc> in the extreme left-hand column of the display and the data is listed in channel groups headed by the channel group label (or name) and group base. The cursor is always positioned in the top line of the display and is indicated by a <c> immediately to the left of the store location. The marker and trigger positions are indicated by an <m> and <t> respectively immediately to the right of the store location column.

Beneath the data there are two lines cross-referencing the user-defined channel group names to the channel group labels, see sections 5.3. and 5.4.

At the bottom of the screen are the soft-keys. Fig 7.1. shows a typical display with the EDIT condition set to OFF; with EDIT set to ON, the soft-keys change with the position of the edit zone, as in menu displays.

Acquisitions can be initiated and stopped from the List display and the display can be manipulated while the acquisition is running although the speed of operation will generally be slower.

7.2. ACQUISITION PARAMETERS SHOWN IN THE LIST DISPLAY

The following parameters associated with the acquisition are given in the information line below the display title:

<samples=> the number of valid samples in the store.

<trig t=> the store location of the trigger word. If the trigger was outside of the store then this is shown as <trig t= ????>.

<clock=> the period of the internal clock used for the acquisition, or <EXT> if an external clock was selected.

Note that the values of the parameters shown are these relating to the acquisition of the data memory currently being displayed. In particular, if the clock parameter is changed on the Configuration menu, it will not change on the List display until an acquisition has been made with those parameters and the results displayed on the List display.

The other parameters shown in the information line, i.e. <loc m=> and <View=>, relate to the data as it is currently displayed and are explained in later sections.

7.3. ACQUISITION/REFERENCE MEMORY SELECTION

EDIT ON/OFF	COMPARE ON/OF	EXECUTE SEARCH	FIND DIFF	MEMORY ACQ/REF	PAGE UP	PAGE DOWN

Soft-key representation

The memory whose contents are to be displayed is selected with alternate presses of the <MEMORY ACQ/REF> soft-key. The currently active memory is shown in reverse video within the soft-key itself.
The acquisition memory is the memory in which the most recently acquired data is stored.

The reference memory may have been loaded from the previous acquisition or any earlier acquisitions saved in non-volatile memory, see section 8.2.

7.4. CURSOR MOVE

EDIT ON/OFF	COMPARE ON/OF	EXECUTE SEARCH	FIND DIFF	MEMORY ACQ/REF	PAGE UP	PAGE DOWN

Soft-key representation

The data at the store location at which the cursor is present is always displayed on the top line, i.e. the cursor is always at the top line of the data display. The cursor position is indicated by <c> at the extreme left of the top line of data; if the cursor is active, i.e. can be moved by the UP and DOWN cursor keys or direct keyboard entries, it is shown in reverse video.

The UP cursor key moves the cursor to the next higher store location (auto-repeating if kept pressed); since the cursor is always positioned on the top line of the display, this has the effect of scrolling the data up the display. The data can be scrolled up the display until the last valid store location is in the top line of data.

Similarly, the DOWN cursor key scrolls the data down the display. The data can be scrolled down the display until the first valid store location is in the top line of data.

Fast cursor moves can be achieved using the <PAGE UP> and <PAGE DOWN> soft-keys which respectively scroll the data UP and DOWN by 16 locations at each key press, auto-repeating if the key is kept pressed. Since the data is soft-scrolled it is possible to rapidly scan the whole data store yet visually check for inconsistencies.

The cursor can also be moved with a direct keyboard entry providing it is 'active'; this is indicated by the <c> being displayed in reverse video. Keyboard entries are made 'calculator-style', i.e. store location 1000 is entered as 1,0,0,0. The first entry enters the number in the least significant position and causes the whole store location field at the cursor position to be shown in reverse video; each subsequent entry appears in the least significant position and increments the previous entry to the next significant digit on the left. Four key entries fill the field and on the fourth entry the cursor is moved to the specified location which is displayed in normal video again.

To move to a low-numbered location the entry can either be made as, for example, 0,0,2,1, so that the move is made on the fourth (1) key press, or it can be entered by pressing 2,1,X, where X terminates the entry and causes the cursor to move. High numbers, outside the range of the currently selected store depth, are accepted but the cursor will only move to the highest location in the store.

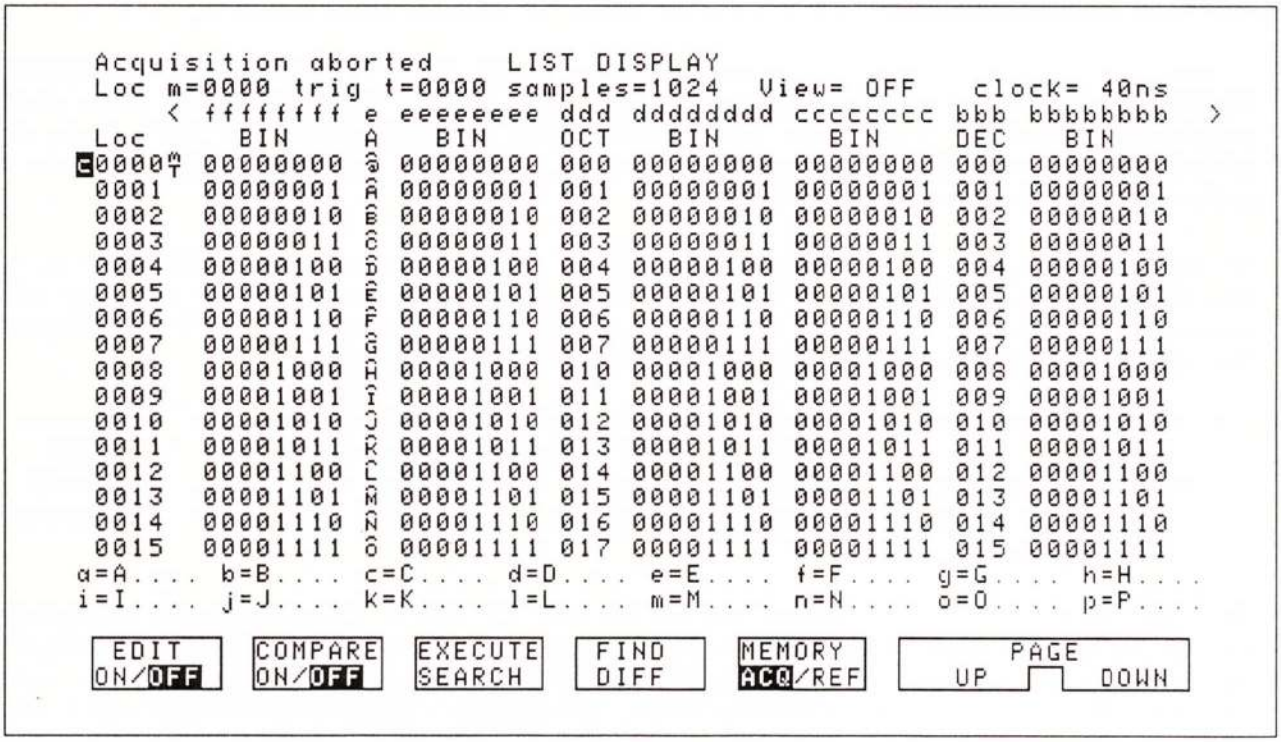


fig 7.2.

Moving the cursor in List display also moves it to the same store location in Timing display.

The LEFT and RIGHT cursor keys are used to scroll all the channel groups into view if they cannot be viewed simultaneously. Fig 7.2. shows a List display which has additional channel groups 'off-screen'. The channel groups to the right are indicated by the > symbol on the far right of the group label line;

these groups can be brought into view by pressing the RIGHT cursor key. Similarly the groups to the left of the channels in view are indicated by the < symbol and can be brought into view by pressing the LEFT cursor key.

7.5. MARKER MOVE

EDIT ON/OFF	SET MARKER	VIEW > SEARCH	(NOT)	VIEW = WORD 1 WORD x		VIEW ON/OFF

Soft-key representation

To move the marker it is first necessary to turn edit <ON> using the <EDIT ON/OFF> soft-key. The edit zone must then be moved to the <Loc m=> field using the UP cursor key; the <m> is shown in reverse video to indicate that it can be edited and the soft-keys change to those shown above. The marker can be moved by 'calculator-style' keyboard entries exactly as for cursor moves from the keyboard described in section 7.4. It can also be set directly to the cursor position by pressing the <SET MARKER> soft-key.

Moving the marker in List display also moves it in Timing display.

7.6. DATA SEARCHING IN THE LIST DISPLAY

EDIT ON/OFF	COMPARE ON/OF	EXECUTE SEARCH	FIND DIFF	MEMORY ACQ/REF	PAGE UP	PAGE DOWN

Soft-key representation

A search for a particular word can be made at any time by pressing the <EXECUTE SEARCH> soft-key. If the word is found, the cursor will move to that store location; subsequent presses of the <EXECUTE SEARCH> soft-key will move the cursor to the next higher store location at which the word is found, and so on until the end of the store is reached.

To select the word to be found it is first necessary to turn edit <ON> using the <EDIT ON/OFF> soft-key. The edit zone must then be moved to the top line using the UP cursor key; the soft-keys change to those shown in 7.5. Pressing the <VIEW/SEARCH> soft-key changes the soft-keys again to:

EDIT ON/OFF	SET MARKER	VIEW SEARCH>	(NOT)	SEARCH = WORD 1 WORD x		VIEW ON/OFF

Soft-key representation

The search word is then specified to be one of the 8 trigger words currently set up on the Trigger menu (see section 5.6) by pressing the <WORD x> soft-key the appropriate number of times until <SEARCH = WORD 3>, for example, is shown in the top part of the soft-key base; pressing <EXECUTE SEARCH> will then initiate a search for <WORD 3>; it is also possible to search for <NOT WORDx> i.e. anything but <WORDx>. Any number of words can be searched for by editing the appropriate trigger word(s) and re-running <EXECUTE SEARCH> on the same data, i.e. a search is not restricted to the words used in the trigger sequence of the acquisition itself. The search for a specified word is made across the full width of the data, not just the channels displayed, and ignores the order and base of the displayed channels. If a search is to be restricted to a certain group of channels then don't cares' must be specified in the remaining channels of that configuration.

When a disassembler option is loaded a further soft-key, <OPTION>, is active:

EDIT ON/OFF	SET MARKER	VIEW SEARCH>	SEARCH = INSTRUCTION (NOT) WORD x	OPTION	VIEW ON/OFF

Soft-key representation

Pressing the <OPTION> key steps the < SEARCH= > field through all the possible cycle types that can be searched for appropriate to that particular option. A maximum of 10 possible cycle types are available but these will differ with each specific option, e.g. the Z80 option will offer <Instruction> <I/O> <refresh>, etc., but the IEEE-488 option will offer <COMMAND>, <DATA>, <INTERFACE CLEAR>, etc.

7.7. COMPARE AND FIND DIFFERENCE IN THE LIST DISPLAY

EDIT ON/OFF	COMPARE ON/OFF	EXECUTE SEARCH	FIND DIFF	MEM ACQ/REF	PAGE UP	PAGE DOWN

Soft-key representation

With edit <OFF> the soft-keys return to those shown above.

A comparison between the acquisition and reference memories can be switched on and off with alternate presses of the <COMPARE ON/OFF> soft-key; the current condition (ON or OFF) is shown in reverse video within the soft-key itself. Differences are shown in reverse video.

A search for a difference can be made by pressing the <FIND DIFF> soft-key whilst the COMPARE is ON. If a difference is found, the cursor will move to that store location; i.e. the difference will move to the top line of the display. Subsequent presses of <FIND DIFF> will move the cursor to next higher store location at which a difference is found, and so on until the end of the store is reached. A search for a difference applies only to those channel groups currently being viewed, i.e. the search ignores channels not displayed and channels that have 'overflowed' the display to the left and/or right.

Comparisons can only be made with reference memories which have data acquired under the same data configuration as specified in the top line of the Configuration menu; the <COMPARE ON/OFF> soft-key will be inoperative if the acquisition and reference memories contain data acquired under different data configurations.

7.8 SELECTIVE DATA LIST DISPLAY (VIEW)

The VIEW facility permits the selective display of specified words or, if a disassembler option has been loaded, specified cycle types.

To specify and view occurrences of a word or cycle type it is first necessary to turn edit < ON > using the <EDIT ON/OFF> soft-key. The edit zone must then be moved to the top line using the UP cursor key; the soft-keys change to those shown below:

EDIT ON/OFF	SET MARKER	VIEW > SEARCH	(NOT)	VIEW = WORD 1 WORD x	OPTION	VIEW ON/OFF

Soft-key representation

The word or cycle type to be viewed is selected by pressing either the <WORD x> or the <OPTION> soft-key the appropriate number of times to bring the desired word or cycle type into the <VIEW => field in the top line of the soft-key box. Any one of the 8 words currently set up on the Trigger menu (see section 5.6) can be selected by the <WORD x> soft-key; any of the cycle types appropriate to the disassembler currently loaded can be selected by the <OPTION> soft-key. <NOT WORDx> and <NOT OPTION> can also be viewed.

View is enabled/disabled with alternate presses of the <VIEW ON/OFF> soft-key; the current status of this selection is always shown in the <VIEW => status field in the second line of the display.

Having set the VIEW feature <ON> the edit mode may be exited and the analyser used without restriction. Note, however, that some operations, such as scrolling the list display, may take longer if the specified view word or cycle occurs infrequently in the data store; this is because the analyser has to search and operate on the whole store in some instances, not just the few lines currently in the display.

7.9. EDITING THE LIST DISPLAY

Fig 7.1. shows the 'default' List display after running an acquisition with the default parameters of the Configuration and Trigger menus; the data is listed in binary in the default channel groups (group <a> for the channels of pod 0, etc.). Note that at switch-on the data displayed will always be that from the last acquisition but it will be displayed in the default format; to display it in the correct format it is necessary to recall the <last run set-up> from non-volatile memory, see section 8.3.

By switching edit <ON> using the <EDIT ON/OFF> soft-key, the channel groups displayed, and the base they are displayed in, can be edited.

7.9.1. Editing Channel Groups in List Display

EDIT ON/OFF	INSERT	DELETE	EDIT LABELS NEXT	PREV	DEFAULT	LAB/NAM

Soft-key representation

Switching edit ON and moving the edit zone (reverse video block) to the channel group label line with the UP and DOWN cursor keys causes the soft-keys to change to those shown above. At any time the edit zone is the width of the whole channel group over which it is positioned (from 1 to 32 channels wide); the RIGHT and LEFT cursor keys move the edit zone along the label line from one such channel group to an adjacent one.
The only channel groups which can be displayed are those which have already been defined in the Trigger menu, see section 5.3. In 400MHz mode, and/or when an acquisition has been made with glitch ON, the groups displayed are further restricted to those of the channels which are operational in such configurations, see Specification (section 1). The valid channel groups can be displayed in any base (not necessarily the base used for that group in the Trigger menu), any number of times and in any order, within the overall constraint of a maximum of 16 different channel groups. If all the channel groups cannot be shown on the screen at once, indicated by arrows at the left and/or right ends

of the channel label line, further channel groups can be brought into view by using the LEFT and RIGHT cursor keys.

With the edit zone positioned over a channel group the <EDIT LABELS> soft-keys have the following functions:

<DELETE> deletes the channel group over which the edit zone is positioned; all the channel groups on the right of the deleted group are immediately scrolled to the left and the edit zone therefore effectively becomes positioned over what was the next group to the right.

<NEXT> changes the channel group displayed at the edit zone position to the next channel group (in alphabetical order), of those channel groups specified on the Trigger menu.

<PREV> changes the channel group displayed at the edit zone position to the previous channel group (in reverse alphabetical order) of those channel groups specified on the Trigger menu.

<INSERT> scrolls the channel group at which the edit zone is positioned, and all channels to its right, over to the right; the edit zone is blank until the channel group to be inserted is specified using the <NEXT> and <PREV> keys or direct entries from the keyboard. If the <NEXT> key is the first key pressed after <INSERT> then the channel group which is first in alphabetical order will be inserted and further presses of <NEXT> will increment the channel group forward through all possible choices as described for <NEXT> above. If the <PREV> key is the first key pressed after <INSERT> then the channel group which is last in alphabetical order will be inserted and further presses of <PREV> will decrement the channel group backward through all possible choices as described for <PREV> above.
The channel group label to be inserted can also be entered directly from the keyboard by pressing the appropriate key (and using SHIFT for characters g through p) after <INSERT>; only labels for those channel groups already specified on the Trigger menu will be accepted from the keyboard.

When channel groups are inserted they are listed in the default base of binary; see section 7.9.2. for changing the channel group base.

<DEFAULT> displays the groups in default order if they have already been specified on the Trigger menu. Since defaulting may cause a complex arrangement to be lost , two presses of the soft-key is required; after the first press the message <re-type to confirm> is displayed on the right-hand side of the top line of the display and a second press is required to actually implement the change. Pressing any other key instead of <DEFAULT> a second time will maintain the existing group status and clear the warning message.

<LAB/NAM> changes the heading at the top of each channel group between the channel group label <a> through <p> to the user-defined name, and vice-versa, with alternate presses.

With the edit zone positioned over a channel group the label can also be edited by a direct entry from the keyboard (using SHIFT for labels g through p).

7.9.2. Editing Channel Bases in List Display

EDIT IT	EDIT BASE					
ON/OFF	BINARY	OCTAL	HEX	DECIMAL	ASCII	OPTION

Soft-key representation

Moving the edit zone to the channel base line with the DOWN cursor key causes the soft-keys to change to those shown above. The RIGHT and LEFT cursor keys are used to move the edit zone to each channel group in turn.

The base for each channel group can be independently set to be BINARY, OCTAL, HEXadecimal, DECIMAL, ASCII, or OPTION (microprocessor mnemonics) using the appropriate soft-keys. The OPTION base can only be specified (and the <OPTIONS> soft-key will only be displayed) if options have been installed, see section 9.1.

Section 8 - Utilities Menu

8.1. INTRODUCTION

The Utilities menu, accessed by pressing the UTILITIES key, has three principle functions. The first is the transfer of data and set-ups to and from non-volatile memory and memory cards. The second is the specification of the variable RS-232, printer and GPIB interface parameters, e.g. RS-232 baud rate, GPIB address, etc. Thirdly, the menu is the means by which RS-232 and GPIB remote-control, etc. are actually initiated.

In addition, the criteria for the sounding of the audible warning signal are specified on this menu.

Fig 8.1. shows a typical Utilities menu with the interfaces set to their power-up default values; the instrument will always default to these values at power-up, with the exception of the buzzer setting which will power-up in the mode last used.

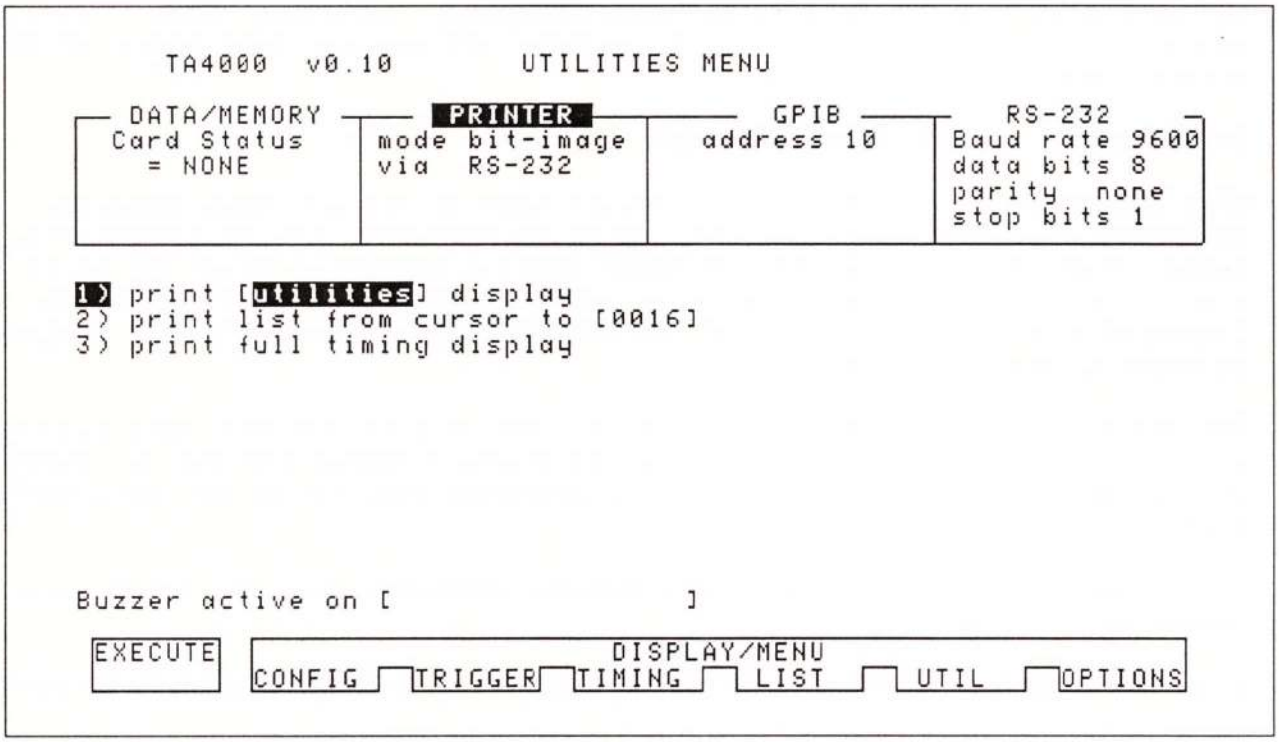


fig 8.1.

On the top line to the left of <UTILITIES MENU> will be displayed the current status of the acquisition once the RUN key has been pressed. To the right of the title will be displayed editing prompts or warnings appropriate to the position of the edit zone and/or the acquisition currently in progress.

Below the title line, the top third of the display is where the current parameters of the RS-232, printer and GPIB interfaces are always displayed and can be edited. The current memory card status (ROM, RAM or NONE) is also shown in this part of the display; for RAM cards, the capacity is displayed too.

Below this is the area where sub-menus are displayed for the function currently being controlled, viz. RS-232, printer, GPIB and data/set-up transfer to/from non-volatile memory and memory cards.

The last line of the menu is used to select the conditions under which the buzzer will sound, and at the bottom are the soft-keys used when editing the

display.

The Utilities menu is edited by moving the edit zone (reverse video block) to the appropriate parameter field. The edit zone is moved around the editable parameter fields by the cursor keys as described in section 3.3.3. Note that, sometimes, more than one field can be edited at a time (e.g. all RS-232 parameters), using the appropriate soft-keys, without extra cursor moves.

Acquisitions can be initiated and stopped from the Utilities menu but no parameters can be edited on the menu while the acquisition is running. If editing is attempted during an acquisition the warning message <no edit during acq> will be shown on the right-hand side of the top line of the display.

8.2 DATA AND SET-UP TRANSFERS TO AND FROM NON-VOLATILE MEMORY/MEMORY CARD

With the cursor zone positioned over the <DATA/MEMORY> field (the default setting), pressing the DOWN cursor brings the edit zone down to the first line of the <DATA/MEMORY> sub-menu. This sub-menu gives the facility to directly reload the last run and default set-ups and to transfer data and/or set-ups to and from acquisition/reference/non-volatile memory and memory cards. It also gives the capabilty for naming and renaming set-ups and data files in non-volatile memory or memory cards.

8.2.1 Loading Last or Default Set-ups

With the edit zone in the first or second line of the sub-menu, pressing the <EXECUTE> soft-key will load the <last> or <default> set-up respectively. Because loading one of the set-ups might cause a complex existing set-up to be lost, without it fully being saved, a warning message <re-type to confirm> is displayed with the first press of the soft-key and a second press is required to actually execute the change.

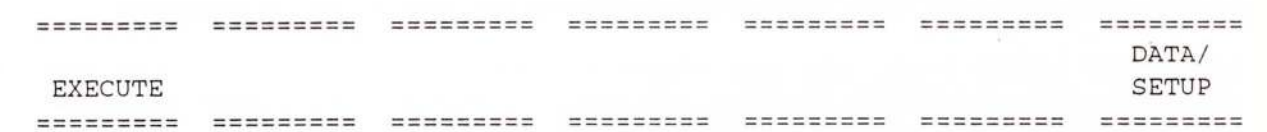
The <last> set-up is the set-up actually used to make the last data acquisition; it is automatically retained in non-volatile memory and can be reloaded at any time, over-writing any new set-up providing that set-up had not actually been run.

The <default> set-up is the simple default condition that is automatically loaded at power up.

8.2.2 Data and Set-up Copying To and From Non-Volatile Memory and Memory Cards

Using the DOWN cursor key to bring the edit zone into the third line of the sub-menu permits the required transfer to be fully specified; the RIGHT and LEFT cursor keys move the edit zone through the three editable fields in turn.

With the edit zone positioned over the left-hand field the soft-keys change to those shown below.



soft-key representation

The field is toggled between <DATA> and <SETUP> with alternate presses of the <DATA/SETUP> soft-key. At the same time, the <DIRECTORY> listed in the bottom third of the display (above the soft-keys) also toggles between <data> and <setup>.

Moving the edit zone to the middle field of the third line changes the soft-

keys to those shown below and enables the <from[ ]> field to be edited, i.e. permits the specification of the current location of the data/set-up to be copied.

		MEMORY SELECT			DIRECTORY	
EXECUTE	ACQ	REF	STORE	CARD	<<	>>

Soft-key representation

Pressing the <ACQ> soft-key inserts <ACQ> in the editable field and will cause the current (i.e. last) acquisition data or setup (as specified by the left-hand edit field) to be transferred when the command is executed.

Pressing the <REF> soft-key inserts <REF> in the editable field and will cause the current reference data to be copied when the command is executed; when <SETUP> has been selected in the left-hand field, <REF> is no longer an option and the soft-key shows <...> instead.

Pressing the <STORE> soft-key causes the STORE DIRECTORY of <data> or <setup> to be displayed above the soft-keys, in step with the selection (<data> or <setup> respectively) in the left-hand editable field of the line. At the same time the store name at the current directory cursor position (indicated by > <) is inserted in the <from [ ]> editable field. Any store can be selected by moving the directory cursors through the STORE DIRECTORY with the <<DIRECTORY and >>DIRECTORY soft-keys.

Pressing the <CARD> soft-key causes the CARD DIRECTORY of <data> or <setup> to be displayed above the soft-keys, in step with the selection (<data> or <setup> respectively) in the left-hand editable field of the line. If no card is fitted, <CARD> is no longer an option and the soft-key shows <...> instead; similarly if small (8k or 16k) memory cards are used which can only store set-ups then <CARD> is replaced by <...> when <DATA> has been specified for copying in the left-hand editable field.

Moving the edit zone to the right-hand field of the third line enables the <to[ ]> field to be edited, i.e. permits the specification of the location to which the data/set-up will be copied when the command is executed. The soft-keys are exactly the same as when the edit zone is in the middle <to[ ]> field and have been fully described above; the one exception is that data cannot be copied into acquisition memory from another source so the <ACQ> soft-key is suppressed and replaced by <...> when <DATA> has been selected in the left-hand field of the line. Similarly, the <CARD> soft-key is replaced by <...> when the card is write protected.

The actual transfer is implemented, once the desired conditions have been specified, by pressing the <EXECUTE> soft-key which is shown when the edit zone is in any of the three editable fields. Because a wanted set-up or data may be over-written by executing this command, a warning message <re-type to confirm> is displayed with the first press of the soft-key and a second press is required to actually execute the copy.

Only store locations containing valid data or set-ups can be copied from; such stores are indicated by showing their names in upper case characters in the <STORE/CARD (data/set-up) DIRECTORY>. If an invalid (e.g. "empty" store) is entered into the <from[ ]> field and a copy execution is attempted, the error message <error in data block> is shown at the right-hand side of the top line of the display and the copy is aborted. Once a successful data or set-up copy has been made the name of that store will be shown in upper case if it had previously contained invalid data.

It is possible that stores that should contain valid data have become corrupted (i.e. invalid), because of back-up battery failure for example, and this will not be discovered until a copy from that store is attempted; at that time the message <error in data block> will be displayed but the name of the store will continue to be shown in upper-case letters.

8.2.3. Naming/Renaming Data and Set-up Stores

Every store in non-volatile memory or memory card has a default name and a name extension. These are:

store nn.sd	for	data stores in non-volatile memory (i.e. the <STORE DIRECTORY (data)>)
set-up nn.ss	for	set-ups in non-volatile memory (i.e. the <STORE DIRECTORY (setup)>)
store nn.cd	for	data stores in memory cards (i.e. the <CARD DIRECTORY (data)>)
store nn. cs	for	set-ups in memory cards (i.e. the <CARD DIRECTORY (setup)>)

Where nn is a number in the range 01 to 30.

Stores are renamed, i.e. given a user-defined name, by moving the edit zone down into the fourth line of the sub-menu using the DOWN cursor key which then permits the store to be selected and the new name specified.

With the edit zone in the left-hand editable field of the fourth line the soft-keys are as shown below:

						DATA/ SETUP
EXECUTE						

Soft-key representation

The <data> or <set-up> directories are selected with alternate presses of the DATA/SECTION soft-key.

Moving the edit zone to the middle editable field with the RIGHT cursor key changes the soft-keys to those shown below:

	MEMORY SELECT				DIRECTORY	
	STORE	CARD			<<	>>

Soft-key representation

The appropriate directory is selected with the <STORE> or <CARD> soft-key; if no memory card is fitted the <CARD> option is not available and the soft-key shows <...>. The store to be renamed is selected from within the directory by moving the directory cursor (> <) through the store using the <<DIRECTORY and >>DIRECTORY soft-keys.

Moving the edit zone to the right-hand editable field permits the new name to be entered; the soft-keys change to those shown below.

CLEAR NAME	SPECIAL CHARACTERS				CHARACTER	
	SPACE	/	*	?	<--	-->

Soft-key representation

Only the first seven characters of the name can be changed; the extensions .sd, .ss, etc. cannot be altered and are there to indicate the nature of the stored information regardless of the name chosen.

The name can be entered directly from the keyboard; any number or character can be used, including the four soft-key <SPECIAL CHARACTERS>. As each character is entered the flashing edit cursor automatically moves one position to the right, ready for the next character to be entered. Alternatively the CHARACTER<-- and CHARACTER--> soft-keys can be used to step through the name character by character without changing them.

8.3. SETTING UP THE INTERFACE PARAMETERS

Fig 8.1 shows a typical Utilities menu with the interfaces set to their power-up default values. The edit zone has been positioned over the <PRINTER> interface parameters; it can be moved to the <GPIB> and <RS-232> interfaces with successive moves of the RIGHT cursor key. For reference, the currently set parameters for all interfaces are always shown in the top third of the display, irrespective of which interface is currently being accessed via the sub-menus in the lower part of display. Appendix 2 details the GPIB, RS-232 and Centronics connector pin-outs.

8.3.1. Specifying the Printer Mode and Interface

	PRINT MODE		INTERFACE			
BIT	HIGH	CHAR	RS-232	CENTRON		

Soft-key representation

With the edit zone positioned over the <PRINTER> interface parameters, the soft-keys change to those shown above; the key functions are described below:

<PRINT MODE>: The <CHAR PRINT MODE> soft-key selects standard character printing; the output is compatible with most printers. The <HIGH PRINT MODE> soft-key selects highlighted character printing for Epson-compatible printers; reverse video on the display is indicated by bold characters on the printout. The <BIT PRINT MODE> soft-key selects bit-image printing. This is slower than character printing but permits a true image of the display to be printed on an Epson compatible printer, including Timing displays and reverse video.

<INTERFACE>: The data to be printed can be outputted via either the RS-232232 or Centronics interfaces; selection is made using the <RS-232 INTERFACE> or <CENTRON INTERFACE> soft-keys respectively.

8.3.2. GPIB Interface Address

ADDRESS					
INC	DEC				

Soft-key representation

Moving the edit zone from <PRINTER> to <GPIB> with the RIGHT cursor key changes the soft-keys to those shown above.

Any address between 00 and 30 can be set using the <INC ADDRESS> and <DEC ADDRESS> soft-keys, or by direct entries from the keyboard.

8.3.3. Specifying the RS-232 Interface Parameters

BAUD RATE		DATA	PARITY		STOP
INC	DEC	BITS	EVE/ODD	EN/DIS	BITS

Soft-key representation

With the edit zone positioned over the <RS-232> interface parameters, the soft-keys are as shown above; the values that can be set for each parameter with these soft-keys are described below:

<BAUD RATE> : The <INC BAUD RATE> and <DEC BAUD RATE> soft-keys step the Baud rate through the values 50, 75, 110, 134, 150, 300, 600, 1200, 1800, 2000, 2400, 3600, 4800, 7200 and 7600 with successive presses; the soft-keys auto-repeat if kept pressed.

<DATA BITS> : 5, 6, 7, or 8 data bits can be set with successive presses of the <DATA BITS> soft-key.

<PARITY> : Parity is ENabled and DISabled with alternate presses of the <EN/DIS PARITY> soft-key; when enabled, the parity is selected to be EVEn or ODD using the <EVE/ODD PARITY> soft-key.

<STOP BITS> : 1, 1.5 or 2 stop bits can be set with successive presses of the <STOP BITS> soft-key.

8.4. SPECIFYING THE OUTPUT TO THE PRINTER

With the cursor in the <PRINTER> field, pressing the DOWN cursor key brings the edit zone down to option 1 of the <PRINTER> sub-menu and the soft-keys change to those shown below:

EXECUTE	DISPLAY/MENU					
	CONFIG	TRIGGER	TIMING	LIST	UTIL	OPTIONS

Soft-key representation

Option 1 can be used to print a screen dump of all menus and displays by selecting the appropriate soft-key. In all cases the menu or display to be printed is first specified in this way and then actioned by pressing the <EXECUTE> soft-key; the first press of <EXECUTE> causes the message <re-type to confirm> to be displayed on the right-hand side of the top line of the display and a second press is required to actually initiate the print. Pressing any

other key instead of <EXECUTE> a second time will cancel the print command. The first character of any print-out is carriage-return; if there is no acknowledgement of this character within 0.5 seconds then the print will be aborted because the analyser assumes that no printer is connected.

At any other time the print can be aborted by pressing the STOP key which returns the analyser to normal operation.

Options 2 and 3, are accessed by further presses of the DOWN cursor key and the soft-keys change again as appropriate. Note that the number of the active option is also shown in reverse video so that it is clear which display will be printed.

All print-outs are specified and executed in a similar way. The complete list of possible print-outs is as follows:

Option No.	**Print Function**	**Options via Soft-keys**
1	Print [ ] display	<Config menu> <Trigger menu> <Timing display> <List display> <Utilities menu> <Options menu>
2	Print List from cursor position to [ ]	<any subsequent store location>
3	Print full Timing display	

Note that options 2 and 3 permit a full List or Timing display respectively to be printed; the channels or store locations are printed contiguously with the title and soft-key blocks being printed only once at the top and bottom respectively.

Note also that option 3 is fixed; only the <EXECUTE> soft-key is active with the edit zone on this line.

8.5. REMOTE CONTROL VIA GPIB

With the cusor in the <GPIB> field, pressing the DOWN cursor key brings the edit zone down to the <GPIB> sub-menu and changes the soft-keys to those shown below:

					GPIB	
					ENABLE	DISABLE

Soft-key representation

Selecting <GPIB ENABLE> cause the message <re-type to confirm> to be displayed at the right-hand side of the top line of the display and a second press is required to transfer analyser control to the GPIB controller. Pressing any other key instead of <GPIB ENABLE> will keep GPIB disabled.

As soon as control is transferred to the GPIB controller, the keyboard is inactive with the exception of the SHIFT key; pressing the SHIFT key can be used to temporarily return the instrument to local control, i.e. until the controller takes control of the analyser again with another command. However, note that the SHIFT key, too, will be disabled if a <local lock-out> interface

command from the controller has been received, and will not become active again until that command has been cancelled. To disable the GPIB control it is necessary to return to local, select the GPIB function on the Utilities menu, and press the <GPIB DISABLE> soft-key. Appendix 1 details the analyser GPIB command set.

8.6. REMOTE CONTROL AND PRINTER OUTPUT VIA RS-232

With the cursor in the <RS-232> field, pressing the DOWN cursor key brings the edit zone down to the <RS-232> sub-menu and changes the soft-keys to those shown below:

				SET STATUS		
				PRINT	MASTER	SLAVE

Soft-key representation

Using these soft-keys the RS-232 status can be set to <print>, i.e. printer port only, <master> or <slave>. Two presses of the relevant soft-key are necessary; the first press causes the message <re-type to confirm> to be displayed on the right-hand side of the top line of the display and the second press activates the selection.

The remote control mechanism adopted for RS-232 communications is that of master-slave, i.e. one analyser whose status has been set as a <master> can control another anlyser set as a <slave>. The following sections describe the facilities in more detail.

8.6.1. RS-232 Status [Print]

The default condition is <RS-232 status [print]>. With this status specified, no further options are listed on the sub-menu and the RS-232 port is available as a printer output only.

8.6.2. RS-232 Status [Master]

If the RS-232 status is set to <master> with the <MASTER> soft-key, further options are listed on the sub-menu. The options define the operations that can be controlled by a <master> analyser to and from a analyser whose status has been set as <slave> (see section 8.6.3). An option is specified by moving the edit zone to the appropriate field; the operation is then actioned by pressing the <EXECUTE> soft-key. The first press of <EXECUTE> causes the message <re-type to confirm> to be displayed on the right-hand side of the top line of the display and a second press is required to initiate the operation; pressing any other key instead of <EXECUTE> a second time will cancel the command. If <master> status has been selected but there is no other analyser connected, for example, the message <communication error> will be shown; all keys become inoperative and the set-up must be aborted by holding down the SHIFT key.
Note that the number of the active option is also shown in reverse video so that it is clear which transfer will be executed.

The complete list of further options is as follows:

Option No.	Option
2	Load master acquisition memory from slave acquisition memory.
3	Load master reference memory from slave reference memory.
4	Send master reference memory to slave reference memory.

5 Load master acquisition set-up from slave acquisition set-up.

6 Send master acquisition set-up to slave acquisition set-up.

7 RUN remote acquisition

8 STOP remote acquisition

These options permit remote control of most operations via RS-232. Refer to section 8.6.4 for further information on remote-control techniques.

Note that it is not possible to move from the <RS-232> sub-menu unless <print> status has been selected, i.e. all remote-control functions must be carried out from the <master> sub-menu.

8.6.3. RS-232 Status [Slave]

If the RS-232 status is set to <slave> with the <SLAVE> soft-key the analyser can be controlled by another analyser set as a <master> via the RS-232 interface, see sections 8.6.2 and 8.6.4.

When the analyser has been set to slave mode the keyboard is disabled with the exception of the SHIFT and STOP keys. The SHIFT key may be used to return the instrument to local operation; the Utilities menu can then be used to deselect slave operation. One press of the STOP key aborts a data transfer, see section 8.6.4.

8.6.4. Master-Slave Remote Control Operation via RS-232

To achieve master-slave remote-control operation via RS-232, one analyser, set locally as a <master>, is connected to another analyser, set locally as a <slave>, via their RS-232 ports, see sections 8.6.2. and 8.6.3.

The RS-232 interface parameters of both the master and slave must first be set as follows:

```
Baud Rate : As required by the communications link
Data Bits : 8
Parity    : None
Stop Bits : 1
```

Note, however, that under some circumstances (e.g. with some modems) it may be necessary to change the baud rate.

The method of operation is to fully define the logic analyser set-up on the master prior to selecting the RS-232 <master> status on the Utilities menu. With the status of the unit to be controlled set to <slave> the set-up can then be transferred to the slave using <master> option 6, see section 8.6.2; the reference memory can also be transferred in this way using <master> option 4.

An acquisition can then be run on a remote unit using <master> option 7; it can also be stopped or aborted using option 8 which functions exactly as the STOP key. Acquisition status messages will be shown on the displays of both the master and slave units.

To display the acquired data on the master unit the information is loaded from the slave using <master> option 2. The master analyser must then be returned to normal operation by selecting <print> status on option 1; the acquired data can then be displayed in the appropriate format by selecting TIMING or LIST.

During the data transfer the message <transfer in PROG> will be shown on the right-hand side of the top line of both the master and slave displays. If the transfer completes successfully the message will clear, if the transfer fails the message will change to <error in block transfer>. A failure in the communication path can cause local lock-up which will time out within 5 seconds. A data transfer operation can be aborted with one press of the STOP key; this may take up to 10 seconds depending on the block size and baud rate of the transfer.

8.7. AUDIBLE WARNING SIGNAL

The conditions under which the audible warning signal will sound can be set by moving the edit zone to the bottom line of the menu, immediately above the soft-keys. The soft-keys change to those shown below:

```
 ========================================  =========  =========  =========
                BUZZER ON
   OFF      ACQ END     ERROR      BOTH
 =========  =========  =========  =========  =========  =========  =========
```

Soft-key representation

The conditions that can be selected are:

<OFF> : Buzzer inoperative

<ACQ END> : Buzzer sounds twice when an acquisition is completed.

<ERROR> : Buzzer sounds once when a keyboard error is made, e.g. split label on the Trigger menu; the buzzer does not sound again until the mistake has been cleared and a further error is made.

<BOTH> : Buzzer sounds under both the conditions described above.

At power-up, the buzzer setting is defaulted to the last condition set.

The buzzer also sounds a number of times during the self-check at power-up and every time a memory card is inserted or removed, to give audible confirmation that the card has been connected/disconnected properly.

Section 9 - Options Menu

9.1. INTRODUCTION

Pressing the OPTIONS key gives access to the currently installed options, primarily microprocessor disassemblers; if no options are installed, the message <NO OPTIONS INSTALLED> will be shown when the key is pressed. The revision of the installed option software is shown beside each option in the menu

9.2. SELECTING AN OPTION

Fig 9.1 shows a typical Options menu when a number of microprocessor disassembler options are installed.

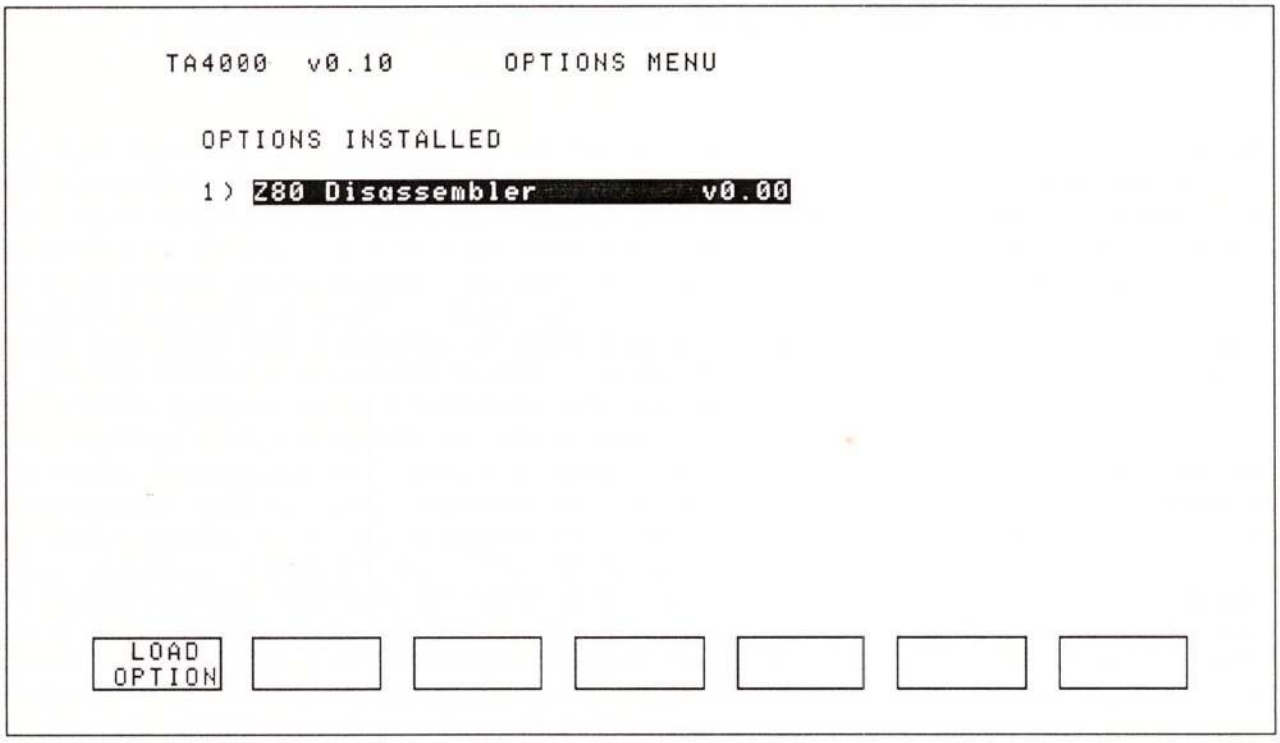


fig 9.1

An option is selected by moving the edit zone to the desired option in the list; the option is then installed by pressing the <LOAD> soft-key. Confirmation that the option has been loaded is given by the message <OPTION (n) LOADED> at the bottom left-hand corner of the screen, where n is the number of the option in the menu. Only 1 option at a time can be loaded.

Full information on using a particular option is contained in the separate manual supplied when the firmware is installed.

Section 10 - Making an Acquisition

This section summarizes the use of the RUN and STOP keys in controlling an acquisition, and lists the acquisition status messages in order of precedence.

10.1 THE RUN AND STOP KEYS

10.1.1. Manual Mode

In manual mode, see section 4.7.1, a single acquisition is initiated by pressing the RUN key. Whilst the acquisition is in progress the message <Acquisition running> will be shown on the left-hand side of the top line of the display. This message will change to <Acquisition complete> if the acquisition successfully finishes or to <Acquisition aborted> if it is terminated by pressing the STOP key. In addition, several possible information or warning messages may be shown on the right-hand side of the top line of the display during and after an acquisition, see section 10.2.

10.1.2. Auto-repeat Modes

In auto-repeat mode, acquisitions will be initiated, completed and re-initiated when the RUN key is pressed until the conditions specified on the Configuration menu are satisfied, see section 4.7.2. The message <Auto acq running> will be shown on the left-hand side of the top line of the display whilst the acquisition is running and the message <Acquisition complete> will be shown between one acquisition and the next. In all cases, however, acquisitions can also be stopped at any time by pressing the STOP key which operates as follows in auto-repeat modes. The first press of STOP during an auto acquisition effectively changes the acquisition to manual mode; the message <Auto acq running> changes immediately to <Acquisition running> (the manual mode message) and no further acquisitions are initiated when the present one is completed (indicated by the message <Acquisition complete>). If STOP is pressed a second time before the acquisition is completed then the acquisition is immediately terminated and the message changes from <Acquisition running> to <Acquisition aborted>; no further acquisitions are initiated until RUN is pressed again. Between acquisitions, however, only one press of STOP is required to inhibit further acquisitions; if STOP is pressed at <Acquisition complete> the message remains unchanged and if it is pressed during <Auto pause> (see section 4.7.2.2) the message will change to <Acquisition complete>.

10.2. ACQUISITION STATUS MESSAGES

The possible acquisition status messages in order of display priority are:

<no edit during acq>	:	momemtary display when a key is pressed during an acquisition
<warning slow clock>	:	with external clock only
<waiting trig step x>	:	equal priority
<waiting trig delay>	:	equal priority
<auto pause>		
<Already running>	:	momentary display when RUN key is pressed during an acquisition.
<Auto acq running>		
<Acquisition running>	:)	
<Acquisition complete>	:)	equal priority
<Acquisition aborted>	:)	

APPENDIX 1. GPIB COMMAND SET

A1.1. INTRODUCTION

The GPIB control facilities provided by the analyser allow for transfers of complete set-ups and data in either direction between it and the controller (or another device on the bus), as well as configuration and control of the instrument by simulating key presses with remote commands. The effect of remote commands is reflected on the screen as they occur. Additional capabilities are available for modifying the behaviour of GPIB-specific interactions such as service request and polling.

A1.1.1. Interface Characteristics

The analyser supports the following IEEE std. 488 interface function subsets:

SH1 AH1 T6 TE0 L4 LE0 SR1 RL1 PP1 DC1 DT1 C0 E2

A1.1.2. Commands

All remote control commands consist of two or three alphanumeric characters. Some commands may be executed a number of times by adding a single digit (1 to 9) after the command to specify the repeat count required. All commands which require the analyser to respond with a message end with a ? character. All commands must be terminated by a delimiter; multiple commands may be placed in a single message to the analyser provided they are separated by a proper delimiter. Upper case and lower case letters may be used interchangeably in all commands.

A1.1.3. Delimiters

The analyser accepts the following characters as delimiters:-

comma
semicolon
carriage return
line feed

There is no distinction made between the different delimiters. Only one delimiter is required at the end of each command; additional redundant delimiters are ignored by the analyser, allowing programmers to choose any convention convenient to the GPIB controller.

A1.1.4. END Message

The GPIB END message (EOI line set true) is not required by the analyser as a listener, provided that an explicit delimiter follows the last command of a message.

As a talker, the analyser terminates every message with a linefeed with END.

A1.1.5. Queuing

The analyser queues input data only while assembling each command: when its terminating delimiter is received the command is executed. If multiple commands are sent in a single message then a Not Ready For Data (NRFD) hold-off will occur at the start of each command in the sequence while the previous command is executed.

Because there is no multi-command queuing, any command which generates a reply from the analyser must not be followed by any more commands (at most two delim-

iters are allowed) before the analyser is addressed to talk and the reply read out. All such commands end with a ? character

A1.2. KEY LEVEL COMMAND SYNTAX

These commands simulate the pressing of keys on the analyser keyboard. Each command consists of a two character mnemonic. In most cases this may optionally be followed by single digit 1 - 9 to specify a repeat count. Separate commands are available for the shifted and unshifted cases of the dual use keys, so there is no command for the SHIFT key itself.

Each command must be followed by a delimiter.

A1.2.1. Menu Keys

M1	CONFIG menu
M2	TRIGGER menu
M3	TIMING display
M4	LIST display
M5	UTILITIES menu
M6	OPTIONS menu

A repeat count is allowed, but not useful.

A1.2.2. Cursor Keys

CUc	Cursor up
CDc	Cursor down
CLc	Cursor left
CRc	Cursor right

<c> is a repeat count from 1 to 9; default 1 if c is absent.

A1.2.3. Softkeys

The softkeys are coded S1 to S7 from left to right. A repeat count is allowed.

A1.2.4. Alphanumeric Keys

Alphanumeric characters are introduced by the command letter K, so digits are coded K1 to K9 and the alphabet KA to KZ. There is no distinction between upper and lower case letters. A repeat count 1 to 9 is allowed.

A1.2.5. Acquisition Control

AR	RUN key
AS	STOP key

A repeat count is not allowed.

A1.2.6. Example

The command sequence:

```
M2,CD3,KX8,AR;
```

causes the selection of the trigger menu, moves the cursor down three times, inserts eight 'X' characters, and starts an acquisition.

A1.3. DATA TRANSFER COMMAND SYNTAX

Data transfer commands are used to invoke block transfers of either complete configuration settings, or complete store contents, to or from the analyser.

A1.3.1. Learn Commands

These commands cause the analyser to originate a block transmission containing the data requested.

TC?	Return CONFIGURATION data
TD?	Return DATA store contents
TR?	Return REFERENCE store contents

Following each of these commands the analyser will set the 'Message Available' bit in the status byte (which may be arranged to cause a service request, see section A1.4.4) and wait until it is addressed to talk. It will then send the data requested in a binary data block containing a CRC (Cyclic Redundancy Check) error check. This block is preceded by the Restore Command needed to return the data to the analyser, and followed by linefeed with END.

A1.3.2. Restore Commands

These commands are followed by a binary data block with CRC error checking containing the data needed. The data is loaded into the appropriate section of the analyser overwriting any previous contents.

TC	Restore CONFIGURATION data
TD	Restore DATA store contents
TR	Restore REFERENCE store contents

It is recommended that users should only attempt to restore data that has been previously learnt from the analyser.

The internal format of the various data blocks is detailed in section A1.5.

A1.3.3. Example

The command:

```
TC?;
```

causes the analyser (when addressed to talk) to send the current configuration in the form:

```
TC,<data block><lf+END>
```

This complete sequence may be sent back to the analyser to restore that configuration at any time.

A1.4. INTERFACE RELATED COMMANDS AND FACILITIES

A1.4.1. Status Byte

The status byte may be read either by a Serial Poll, or by sending the command:

ES? Return Status Byte

Each bit in this status byte contains a separate indication; all are active high and are defined as follows:-

Bit	Definition	
7	Error	- clears when the error code is read
6	'I requested service'	- clears after serial poll
5	Message available	- the analyser should be addressed to talk
4	Command complete	- the analyser is waiting for a command
3		
2	Last find failed	- clears when next find executed
1	Acquisition running	- clears when acquisition is complete
0	Acquisition complete	- clears when acquisition is initiated

A1.4.2. Error Code Register

If an error occurs during the execution of GPIB commands, the ' Error' bit in the status byte is set to 1; this will normally cause a service request (see section A1.4.4). An indication of the cause of the error is placed in the error code register. This code may be read by the command:

ER? Return ERROR code

Receipt of this command causes the analyser to set the 'Message available' bit in the status byte and wait to be addressed as a talker. It will then return the error code as a single byte binary value followed by 'Linefeed' with the EOI line set true.

The ' Error' bit will remain set until the error code register is read, when it is cleared.

Error codes

Bit	
0	Error in block transfer (wrong length, or CRC failed)
1	Syntax error in command
2	RAM error (RAM transfer fails checksum)
3	No edit during Acquisition
4	Split label
5	Clock > MAX
6	Depth > MAX
7	Illegal value

A1.4.3. Acquisition Status Codes

The acquisition status may be read at any time by the command:

EA? Return acquisition status code

Receipt of this command causes the analyser to set the 'Message available' bit in the status byte and wait to be addressed as a talker. It will then return the status code followed by 'Linefeed' with the EOI line set true.

Status codes

Code	
00	Power Up State
01	Waiting Trig Step 1
02	Waiting Trig Step 2
03	Waiting Trig Step 3
04	Waiting Trig Step 4
05	Waiting Trig Delay
06	Warning Slow Clock
10	Auto Pause
OC	Acquisition Aborted
OD	Acquisition Complete

A1.4.4. Service Request

The analyser implements a selective Service Request mechanism under the control of a Service Request Enable mask which is specified by the controller using the command:-

EMv Set SRQ Enable Mask to v (which is a one byte binary value).

This mask determines which bits of the Status Byte are to cause a service request, according to the following rules:-

If a bit in the mask is 0, then the corresponding bit in the status byte will never cause a Service Request.

If a bit in the mask is 1, then a service request will be generated whenever the corresponding bit in the status byte makes a transition from 0 to 1 as a result of some activity within the analyser.

When an EMv command is received, the new mask value is compared to the old, and the following rule applied:-

If any bit in the mask has changed from 0 to 1, and the corresponding bit in the status byte is already 1, then a service request is generated.

This facility may be used to defer the generation of a Service Request by the analyser until a time convenient to the controller program.

The default value of the SRQ Enable Mask is 80 Hex, so only Command Errors will cause a Service Request. Bit 6 of the mask value has no significance, and may be set high to make v a printing character.

A1.4.5. Parallel Poll

Full remote configuration Parallel Poll (PP1) facilities are provided by the analyser. The standard PPC PPE PPD and PPU interface messages specify which DIO interface line is to be used for the Parallel Poll response, and which

logic sense of the individual status bit (ist) to be tested.

Additionally the analyser allows the controller to select any one bit of the Status Byte as the ist message by the command:

EPn Select ist for Parallel Poll

where 'n' is a digit (0 to 7) indicating the bit number required. The default value is 6, the 'I requested service' bit.

A1.4.6. Device Clear

Either Device Clear interface message (DCL or SDC) will cause the analyser to be initialised as if by a power on reset, except that GPIB control will remain enabled.

A1.4.7. Device Trigger

The Group Execute Trigger interface message is treated as equivalent to the AR key level command or the RUN key. Any properly delimited command sent to the analyser before the GET message will be completely executed (including any repeat count) before the trigger is acted on.

A Not Data Accepted (NDAC) hold-off will occur on the GET message until the analyser starts to process the trigger.

A1.4.8. Interface Clear

In response to the Interface Clear signal the analyser will release any NDAC holdoff, remove any Service Request, and return to the Talker and Listener Idle states. It does not abort any internal software operation in progress, and the interruption in GPIB communication may make it impossible for an operation to complete properly. It is therefore recommended that Interface Clear be followed by Device Clear unless it is known that the analyser was in an idle condition.

A1.4.9. Remote/Local State Switching

After GPIB control is enabled in the Utilities Menu, the analyser will enter the Remote state when it is first addressed to listen by the controller. In this state the front panel keyboard cannot be used for local control of the instrument.

An operator may request a Return to Local control by pressing the SHIFT key. If Local Lockout is not in force this request will be accepted, and the keyboard re-enabled until the analyser is again addressed to Listen, when it re-enters the Remote State.

The controller may prevent this action by sending a Local Lockout interface message to the analyser.

The controller may enable the front panel for Local control by sending the Go to Local interface message, regardless of the state of Local Lockout.

A1.5. DATA FORMATS FOR BLOCK TRANSFERS

A1.5.1. Data Store TC and TD Commands

TC or TD	The command identifier
,	Separator
	Block identifier
C	Block type - binary data with two byte CRC
Length MS	Block length most significant byte
Length LS	Block length least significant byte
Store Data	The store data
Check Bytes	The CRC of all store data bytes
	Block identifier
C	Block type - binary data with two byte CRC
Length MS	
Length LS	
Store Parameters	The data store acquisition parameters
Check Bytes	The CRC of all the store parameters bytes
LF and END	Line feed sent with EOI true

A1.5.2. Data Store Configuration

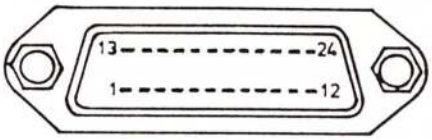
Data is stored in 10 Byte blocks, 0-9, 10-19, 20-29, etc. to the end of the store. The table below shows which channels are stored in which bytes.

In 8-channel or 16-channel configuration (i.e. 400MHz mode for 32/48-channel and 80-channel instruments respectively), data is stored in successive locations as indicated by the suffixes a,b,c, etc., in the table below.

BYTES	0	1	2	3	4	5	6	7	8	9
32-Channel Analyser										
32-channel	0-7	8-15	16-23	24-31	..	..	..	..	..	..
32+glitch	0-7	8-15	16-23	24-31	..	..	..	..	..	0-7GLT
8-channel	0-7a	..	0-7b	..	0-7c	..	0-7d	..	0-7e	..
48-Channel Analyser										
48-channel	0-7	8-15	16-23	24-31	32-39	40-47	..	..	..	..
48+glitch	0-7	8-15	16-23	24-31	32-39	40-47	..	..	..	0-7GLT
8-channel	0-7a	..	0-7b	..	0-7c	..	0-7d	..	0-7e	..
80-Channel Analyser										
80-channel	0-7	8-15	16-23	24-31	32-39	40-47	48-55	56-63	64-71	72-79
72+glitch	0-7	8-15	16-23	24-31	32-39	40-47	48-55	56-63	64-71	0-7GLT
16-channel	0-7a	..	0-7b	..	0-7c	..	0-7d	8-15a	0-7e	8-15b
	0-7f	8-15c	0-7g	8-15d	0-7h	8-15e	0-7i	8-15f	0-7j	8-15g

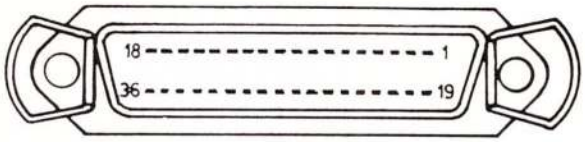
APPENDIX 2. INTERFACE CONNECTOR PIN-OUTS

GPIB Connector



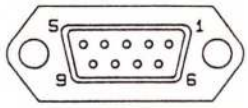
Pin	Signal
1	DI01
2	DI02
3	DI03
4	DI04
5	E0I
6	DAV
7	NRFD
8	NDAC
9	IFC
10	SRQ
11	ATN
12	OV
13	DI05
14	DI06
15	DI07
16	DI08
17	REN
18	OV
19	OV
20	OV
21	OV
22	OV
23	OV
24	OV

Centronics Connector



Pin	Signal
1	STROBE Output to printer
2	DATAO (LSB)
3	DATA1
4	DATA2
5	DATA3
6	DATA4
7	DATA5
8	DATA6
9	DATA7 (MSB)
10	N/C
11	BUSY Input from printer
12	N/C
13	N/C
14	N/C
15	N/C
16	OV
17	N/C
18	N/C
19	OV
20	OV
21	OV
22	OV
23	OV
24	OV
25	OV
26	OV
27	OV
28	OV
29	OV
30	OV
31	N/C
32	N/C
33	OV
34	N/C
35	N/C
36	N/C

RS-232 Connector



Pin	Signal	
1	DCD	Carrier detect output
2	TXD	Transmit data output from analyser
3	RXD	Receive data input to analyser
4	DTR	Data terminal ready output
5	PG	Protective ground
6	DSR	Data ready input
7	CTS	Clear to send input
8	RTS	Request to send output
9	SG	Signal ground

The analyser is configured as a Data Terminating Equipment (DTE)

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